EDISON ELECTRIC INSTITUTE BULLETIN

GEOGRAPHY; RESOURCES & INDUSTRIES

MARCH, 1941

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EDISON ELECTRIC INSTITUTE

THE ELECTRIC LIGHT AND POWER INDUSTRY

Current Statistical Data Covering 100 Per Cent of Industry

December, 1940

CLASSIFICATION OF SALES (Revised Series)

	1940	1939	%
Number of Customers as of DECEMBER 31st			
Residential or Domestic	24,951,906	23,965,035	+ 4.1
Rural (Distinct Rural Rates)	685,812	634,249	+ 8.1
Commercial or Industrial:			
Small Light and Power	4,260,255	4,215,254	+ 0.9
Large Light and Power	177,905	184,299	
Street and Highway Lighting	24,147	25,032	.....
Other Public Authorities	89,480	80,078	.....
Railways and Railroads:			
Street and Interurban Railways	198	207	.....
Electrified Steam Railroads	27	31	.....
Interdepartmental	1,271	1,121	.....
Total Ultimate Customers	**30,191,001**	**29,105,306**	**+ 3.7**
Kilowatthour Sales During Month of DECEMBER			
Residential or Domestic	2,222,268,000	1,978,419,000	+12.3
Rural (Distinct Rural Rates)	108,912,000	113,765,000	− 4.3
Commercial or Industrial:			
Small Light and Power	2,033,724,000	1,877,173,000	+ 8.4
Large Light and Power	5,448,145,000	4,672,628,000	+16.6
Street and Highway Lighting	216,601,000	211,415,000	+ 2.5
Other Public Authorities	248,045,000	216,867,000	+14.4
Railways and Railroads:			
Street and Interurban Railways	368,012,000	360,227,000	+ 2.2
Electrified Steam Railroads	182,571,000	171,280,000	+ 6.6
Interdepartmental	66,740,000	52,420,000	+27.3
Total to Ultimate Customers	**10,895,018,000**	**9,654,194,000**	**+12.9**
Revenue from Ultimate Customers	**$219,913,100**	**$204,863,600**	**+ 7.3**

RESIDENTIAL OR DOMESTIC SERVICE (Revised Series)

Average Customer Data for the 12 Months Ended DECEMBER 31st			
Kilowatthours per Customer	952	897	+ 6.1
Average Annual Bill	$36.56	$35.88	+ 1.9
Revenue per Kilowatthour	3.84¢	4.00¢	− 4.0

GENERATION FOR THE U. S. POWER SUPPLY AS A WHOLE FOR THE MONTH OF DECEMBER
(000's kwhrs)

	1940	1939	%	1938	1937
Fuel	8,797,038	8,630,716	+ 1.9	6,734,882	6,213,918
Hydro	4,302,187	3,105,261	+ 38.5	3,814,802	3,563,838
Total	**13,099,225**	**11,735,977**	**+ 11.6**	**10,549,684**	**9,777,756**

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EDISON ELECTRIC INSTITUTE BULLETIN

Volume 9 MARCH, 1941 No. 3

New Construction Will Keep Generating Capacity Well Ahead of Demand

NEW construction already under way or planned by the electric utilities continues to mount in total and should keep the nation's electric generating capacity well ahead of any increased demand due to the defense program. At the end of 1940 the total installed capacity exceeded demand by 32 per cent, and the new construction should more than maintain this ample margin.

Present schedules call for installation in 1941 and 1942 of 6,715,000 kilowatts of new generating capacity, an amount approximately 30 per cent greater than was ever installed in any previous two-year period. Of this total, 6,354,000 kilowatts is scheduled for central station installation and the remainder in industrial plants.

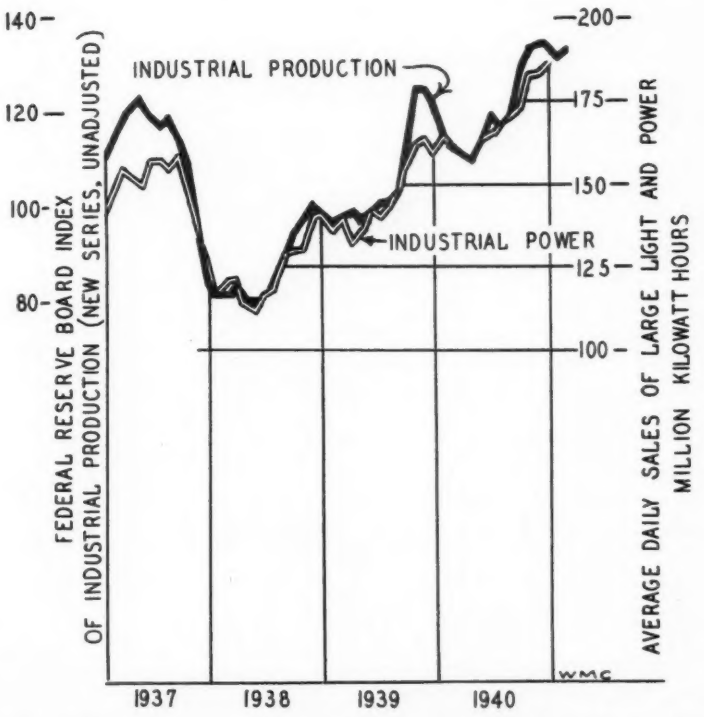
New central station installations amounting to 3,397,000 kilowatts of generating capacity announced for 1941 are being completed as scheduled. The generating capacity scheduled for installation in central stations in 1942 now totals 2,957,000 kilowatts, this amount having been raised 655,000 kilowatts since the first of the year. Additional capacity of 800,000 kilowatts more is already scheduled for 1943, and 620,000 kilowatts for 1944.

During 1940 the sum of the peak demands for electricity increased 2,200,000 kilowatts to the highest level on record, which was 7.5 per cent above the sum for 1939. Earlier estimates of peak demand were exceeded by 9 per cent in some localities but by slightly less than 2 per cent in the country as a whole. Barring unforeseen developments, the peak demand is expected to increase in 1941 about as much as it did in 1940, and by a somewhat lesser amount in 1942.

The margin of reserve generating capacity is fairly uniform in percentage throughout the country, the lowest area having little less than the average. New construction programs are planned to meet expected increased loads in each area. But few isolated cases of shortage may therefore be expected. New construction in the industrial area east of the Mississippi River will add 4,680,000 kilowatts including 350,000 in industrial plants, in the next two years.

Higher Energy Output from Existing Generating Capacity

Electric power output of recent months compared with corresponding figures of peak demands on generating plants reflects the longer working hours of munitions factories. From June to November peak demand increased at about the same rate as energy output. In December, January and February, however, energy output increased 20 to 25 per cent faster than peak demand. This difference was most pronounced in the New England, Middle Atlantic and Great Lakes States, in which increased energy output exceeded increased demand by more than 30 per cent. As the defense program advances further into the production stage with two and three operating shifts becoming the rule in manufacturing plants, this trend toward greater energy output from existing generating capacity will increase correspondingly.



The close relationship between sales of electric power and industrial production is illustrated by this chart.

New Standard EEI-NEMA 1½ Kva Transformer Has 120 Volt Secondary

IT is well known that the use of the 1½ kva distribution transformer is largely confined to rural areas where in many cases it has sufficient capacity to serve a single farm customer, providing this customer has no heavy duty appliances such as an electric range, water heater, or large motor. The maximum demand of such a farm customer is created almost entirely by lighting, flat iron, toaster, radio, refrigerator, hot plate, roaster, or small pump, all of which require service at 120 volts.

In some cases where customers have been supplied from a 1½-kva 120/240-volt transformer with a three-wire service, sufficient thought may not have been given to the effect of unbalanced loads on a small transformer designed primarily to supply its maximum output at 240 volts, or a well balanced load at 120 volts on each half-winding.

Due to the large number of 1½-kva transformers being used the EEI-NEMA Joint Committee on Standards for Distribution Transformers recognized the desirability of obtaining the advantages of a 120-volt 2-wire secondary in a simplified 1½-kva transformer. Tests and data were available on many installations, and after careful study of the situation the committee unanimously recommended the 120-volt 2-wire secondary as standard for transformers of this rating. At the same time they made available on a listed basis transformers with a 3-wire secondary to those operators desiring to continue the 3-wire practice.

Some of the important reasons why the 1½-kva transformer should be limited to a 120-volt secondary are:

1. *The effect of load unbalance* is to cause excessive voltage regulation. For instance, the effect of complete load concentration on ½ of the secondary winding is to increase the normal voltage regulation of the transformer by more than 50 per cent above its regulation at 240 volts.

From many actual tests on small transformers of various voltages, styles and impedance characteristics, illustrations here have been selected representing actual tests on 1½-kva 4800-volt transformers, one having a 120/240-volt secondary and the other having only a 120-volt secondary. The transformers had normal characteristics and supplied the customer over a short service. These actual tests are of interest inasmuch as they represent typical situations which now exist in many thousands of installations. This is undoubtedly the result of the difficulty in maintaining balanced loads on the average 1½-kva installation.

It is obvious that the voltage of the customer served by a 120/240-volt transformer is not as suitable as the voltage supplied by a transformer having only a 120-volt secondary and that, if all such customers were served with 120-volt transformers, a better grade of service could be provided at a reduced cost and with greater customer satisfaction.

2. *The demands of present day 120-volt appliances* are exceedingly large in comparison with the capacity of one half of a 1½-kva transformer.

The wattage of incidental appliances has been steadily increasing for several years until present day values of the common heating appliances found in nearly every residence are such as: electric iron 1000-1200 watts; hot plate 1350 watts; roaster 1600 watts, etc.

3. *The presence of a three-wire service* permits the installation of heavy duty 240-volt appliances, such as an electric range, from a 1½-kva transformer without knowledge of the utility company, often resulting in burned-out transformers.

Several instances have been reported where just this sort of thing happened with modern electric ranges connected to small three-wire transformers. These ranges, having been installed without the knowledge of the utility company, caused the transformers to burn out.

4. *The cost of 1½-kva transformers has been reduced substantially* by the adoption of a two-wire, 120-volt secondary.

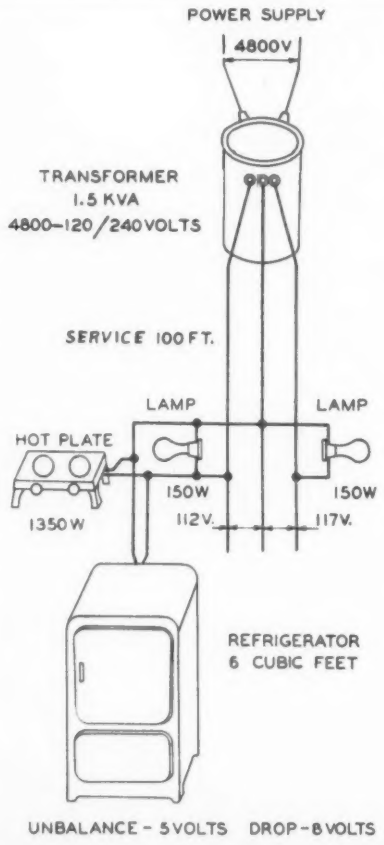


Fig. 1—Heavy Unbalance—High Drop

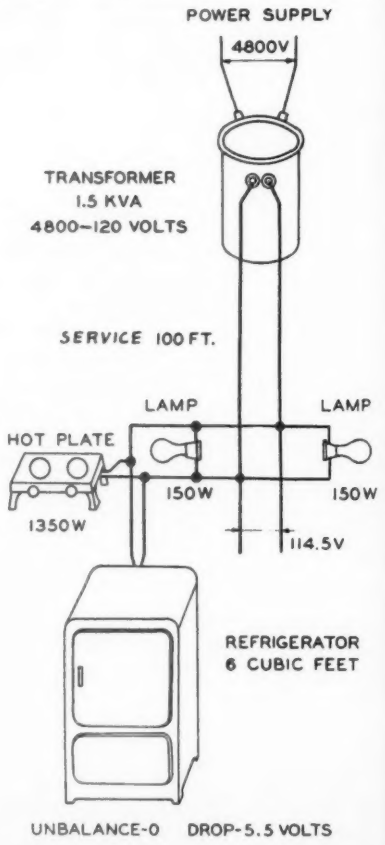


Fig. 2—No Unbalance—Low Drop

Deep Underground Conduit Installation

Using Caisson, Casing and Sluicing Methods

By L. G. Colson

Consolidated Edison Co. of New York, Inc., New York, N. Y.

A paper presented at a meeting of the Transmission and Distribution Committee, EEI, Detroit, Mich., Feb. 17-19, 1941

THIS paper describes the installation of an underground conduit line comprised of multiple precast concrete ducts, by a method which eliminated trenching.

The usual and well known method of installing underground conduit is, of course, to dig a trench to the required depth between manholes or underground terminals, lay the ducts in the trench, backfill and, if the installation happens to be in a paved street, restore paving. Furthermore, if the ducts have to be laid at a considerable depth below street surface, it is necessary to shore up the trench to prevent cave-in and to provide safety to the workmen. Any means of installing conduit which will eliminate trenching will necessarily involve either pushing, boring or tunneling from one underground terminal to the other, or some combination of these principles. The reasons for employing a method of this nature in preference to the trenching method may thus be summarized:

1. Deep trenching and resulting shoring are eliminated under the following conditions:

(a) Where the space at normal depth below street surface is congested by subsurface structures to the extent that any additional conduit must be installed at a greater depth.

(b) Where a change in street grade necessitates an increase in the depths of system manholes and a corresponding increase in the depth for the conduit installation.

2. The cutting and patching of sur-

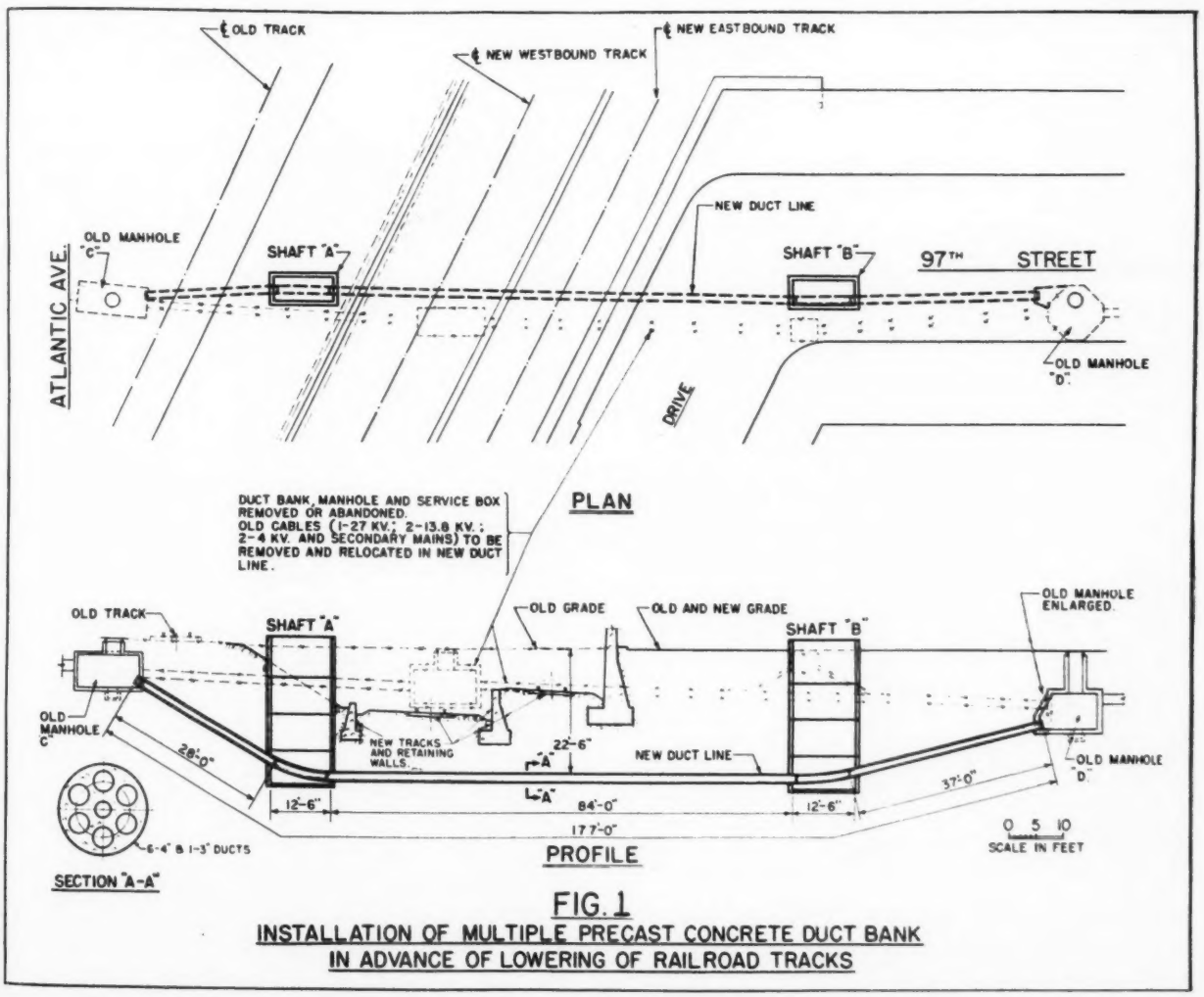


FIG. 1

INSTALLATION OF MULTIPLE PRECAST CONCRETE DUCT BANK IN ADVANCE OF LOWERING OF RAILROAD TRACKS

Fig. 1—Installation of Multiple Precast Concrete Duct Bank in Advance of Lowering of Railroad Tracks

Fig. 2—Typical Conduit Installation by Conventional Trenching Method

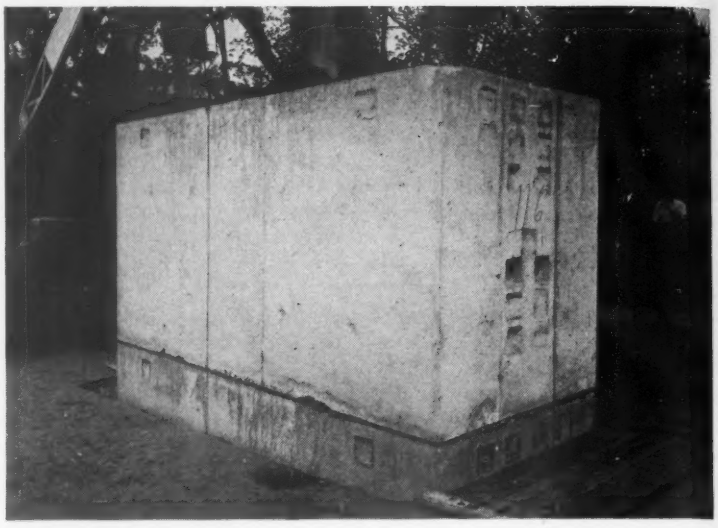


Fig. 3—Sinking of Shaft by Means of Precast Manhole Walls and "Caisson" Method of Installation

Fig. 4—Top View of Shaft

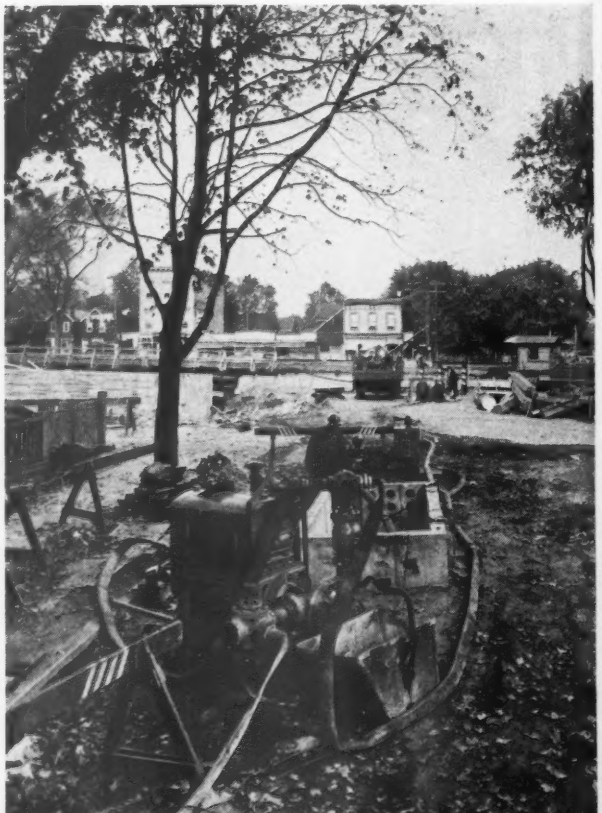


Fig. 5—Location of Conduit Installation Showing Railroad Project, Shafts and Equipment

faces of various parkways and express highways are eliminated.

3. Traffic congestion, delays and hazards which might result in certain streets from the disturbance of street surface by the trenching method are prevented; the earth is removed from one point.

4. Greater safety to pedestrians and utility company forces is provided.

Figure 2 illustrates a typical conduit installation being made by the usual trenching method. It is shown as a contrast to the method which is to be described.

Nature of Project

Figure 1 shows plan and profile views of a layout of a conduit installation recently made by the Consolidated Edison Company of New York, Inc. where the installation was made without trenching. A railroad project, involving the lowering of a number of tracks from grade level to a depth several feet below grade, necessitated the relocation of the old conduit line between manholes "C" and "D" from normal depth to a suitable depth below the new railroad retaining walls. Moreover, the old conduit line contained a number of important high tension cables which had to be maintained in service. The new conduit line, 177 ft. in overall length, was installed at a depth of approximately 22 ft. below old street grade at the center portion with upward slopes at the ends into the two manholes.

To relocate the conduit line by the usual method would have required temporary maintenance of cables and deep trenching and shoring. Furthermore, the portion below the old tracks would have required special shoring by the railroad company forces. With the method employed, however, the old conduit line and the cables remained undisturbed throughout the construction of the new line, after which time the cables were rerouted in the normal manner.

Sinking of Shafts by Standard "Caisson" Method

The first step in the procedure was to provide the two shafts designated as "A" and "B" in Figure 1 so that the new conduit could be installed at the required depth below the bottoms of the new railroad retaining walls. These shafts were sunk to a depth of approximately 24 ft. below street grade and each consisted of four standard precast concrete manhole walls, each 6 ft. 6 in. high and weighing approximately 9¾ tons, set one upon the other and lowered to the required depth.

The walls were lowered by the "caisson" method of installation previously adopted as standard for installing precast line manholes and transformer vaults. This consists of excavating from within the walls by means of a truck crane equipped with a clam shell bucket. Men enter the walls from time to time to loosen the soil remaining under the walls, allowing the manhole to sink slowly. After the first set of walls had been lowered in this manner to nearly full depth, grouting was applied to the top and the second set of walls was set on top of the first as illustrated in Figure 3. The excavation then continued in like manner with the subsequent addition of the third and fourth set of walls until the desired depth had been reached.

The lower portion of each shaft was then reinforced along the walls and cross braced with steel and wood members as a safety measure against rupture from earth pressure. A floor and sump were next installed to insure water tightness, followed by the breaking of holes in the ends of the shafts to allow the new conduit to enter. Figure 4 shows a top view of one of the shafts with part of the reinforcing steel installed and before the floor and sump were provided. These shafts, together with the two manholes, furnished the working spaces for the installation of the new conduit line.

Figure 5 is a view looking towards the tracks and taken from a position in front of manhole "D." Shafts "B" and "A" are seen adjacent to the pumps and truck respectively, whereas manhole "C" is located beyond the truck between the old tracks. The partially completed railroad excavation and retaining walls may also be seen at the left. The pump just beyond the shaft is a suction pump used to remove sluicing water from the shaft and the one on the near side is a pressure pump which was used in the sluicing process. Further details concerning the pumps and the use of water will be given later.

Multiple Precast Concrete Duct

The new conduit line, except for the portions consisting of standard 4 in. fibre ducts within the two shafts, required because of the bends in the line, is comprised of 4 ft. long sections of multiple precast concrete duct having an outside diameter of 15½ in. Figure 6 illustrates a typical section of this multiple duct. It consists of six 4 in. outer ducts and one 3 in. center duct, but the center duct is not normally used except possibly for control cables and the like. The end configurations of each section provide the means of joining the various sections. The collar shown is used to exclude soil from the ducts at the junction and to provide added support.

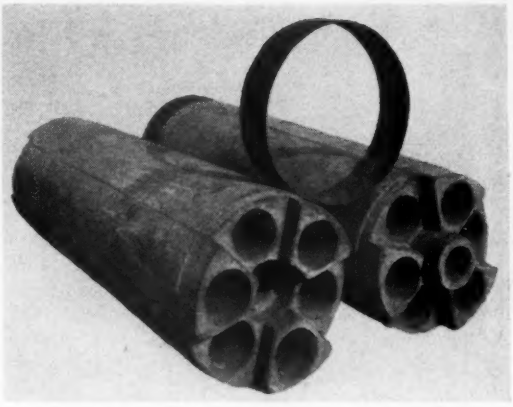


Fig. 6—Multiple Precast Concrete Duct Sections and Collar

Installation and Apparatus

In general, the method employed to install the multiple duct is as follows:

A casing, comprised of short interlocking sections of steel pipe, is first pushed into the ground from one underground terminal toward the other until the casing connects the two terminals, the soil being removed from within the casing during the pushing operation. The next step is to eject the sections of steel casing into the opposite terminal by continuing the pushing process with sections of the duct until the last section of casing has been pushed out and the duct connects the terminals.

The casing sections have an outside diameter of 16 in., being slightly larger than that of the duct, have a length of 4 ft. and are equipped with lugs at one end to couple the various sections together.

Pushing the sections of casing and duct into the ground was effected by means of a hydraulic pipe pusher, rated at 75 tons pressure, operating on a notched rail. A motor driven oil pump forced oil through a high-pressure hose into the cylinders of the hydraulic pusher, causing its power unit to move forward on the base.

As was stated before, sluicing with high-pressure water was utilized on this

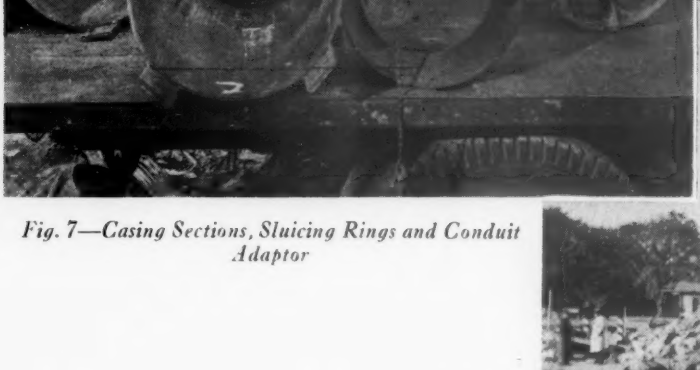


Fig. 7—Casing Sections, Sluicing Rings and Conduit Adaptor

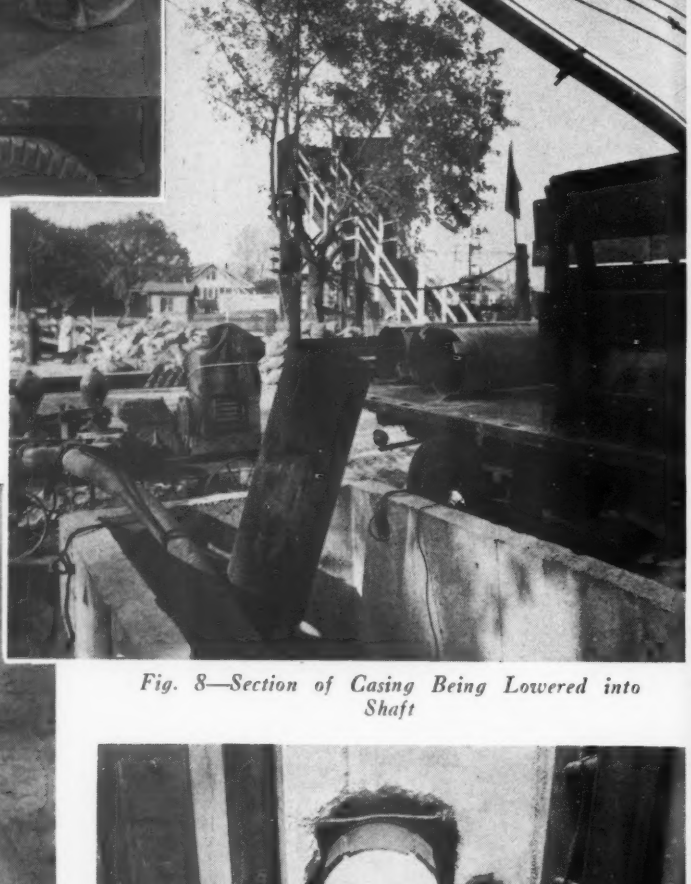


Fig. 8—Section of Casing Being Lowered into Shaft

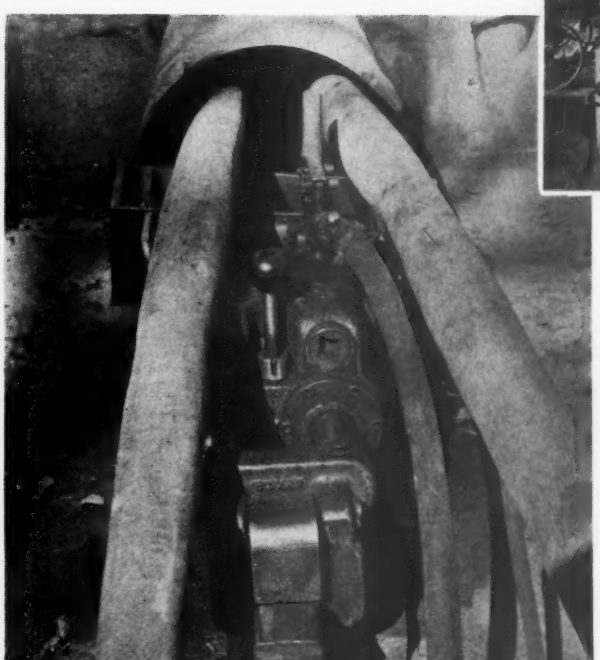


Fig. 9—Typical Pushing Set-Up Showing Water Hoses, Hydraulic Pipe Pusher and Oil Hose Connections

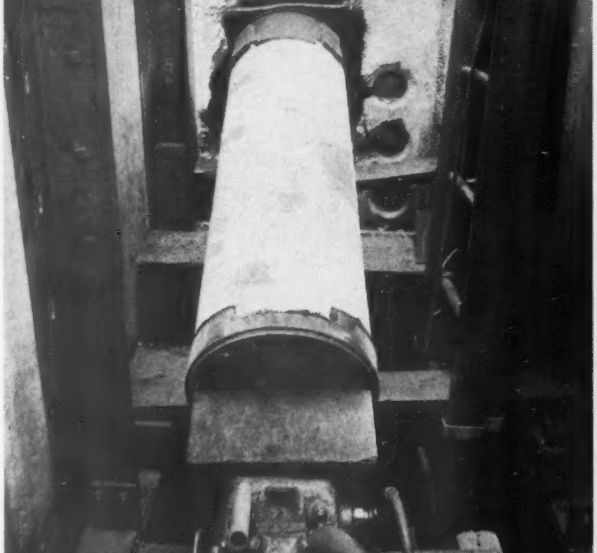


Fig. 10—First Conduit Section Being Pushed After the Casing Sections

installation. This provided the means by which the soil was removed from within the casing during the pushing operation.

A sluicing ring shown second from the left in Figure 7, is welded on the inside of the leading section of casing a short distance from the front end with a hose connection pointing toward the rear. The ring contains a series of small water holes around its periphery on both its front and rear sides, directed slightly toward the front and rear respectively. The water, forced at high pressure through these holes, served to soften and break down the soil. The lower segment of the ring has, in addition to the small holes, a number of larger holes directed to the rear and parallel with the bottom of the casing. The water from these holes forced the soil backward along the bottom of the casing and into the shaft from where the pushing was being done.

In order to supplement the sluicing action of the front ring as the distance increased, additional sluicing rings, shown second from the right in Figure 7, were added at intervals along the casing and supplied by a second hose connection. Also shown in this illustration, at the extreme left, is a normal casing section; at the extreme right is a multiple duct to fibre conduit adapter used in the two shafts.

The pump supplying these rings is a self priming centrifugal pump rated at 150 pounds per square inch pressure and 300 gallons per minute. It was connected to a hydrant on the suction side and is fitted on both suction and discharge sides with 3 way 3 port valves. With this type of valve and the two separate hose connections, water could be confined to the end rings only if desired in order to obtain maximum pressure at this point, to the intermediate rings only, or to both hoses simultaneously. Additional pumps brought the soil and water from the bottom of the shafts to the street surface.

Figure 8 illustrates the manner in which the casing sections were lowered into the shafts for installation.

A typical pushing setup is shown in Figure 9. It includes the 75 ton hydraulic pipe pusher on its notched rail, the pushing plate and hose connections. The large hose on the left supplies the end sluicing ring and the one on the right the intermediate rings. The two smaller hoses are oil line connections to the oil pressure pump.

Figure 10 is a view taken at the bottom of one of the shafts showing the manner in which the first section of multiple duct was pushed into the ground. As this first section of duct advanced, the leading section of casing was pushed out into the opposite terminal. Succeeding sections of duct were then added until all sections of casing had been pushed out and the duct extended into the opposite terminal.

Fig. 11—Salvaging Shaft Walls

The conduit installation was made in three sections. The pushing equipment was first set up in one of the shafts and the line pushed to the opposite shaft. The equipment was then reversed and the installation between the shaft and manhole was made. Thereafter, the pushing equipment was moved to the other shaft and the final section installed. The next step was to piece out the three sections and form the bends in the two shafts. This was done by means of adapters and single 4 in. fibre conduit which were then encased in a concrete sheathing.

Salvaging Shaft Walls and Closing the Shaft

Rather than fill in the shafts completely, it was decided that the lower halves of both should be retained in the event additional ducts should be required at a later date. The next step, therefore, was to remove some of the bracings and install a precast roof in each shaft between the second and third tiers of manhole walls. Access was provided by extending standard concrete sewer pipe sections, having an inside diameter of 3 ft., from an opening in each roof to levels adaptable to ultimate grades, terminating in a collar base upon which standard manhole frames and covers were installed. A fixed ladder was provided in each of these sewer pipe chimneys.

The tops of both shafts projected somewhat above old grade and the shaft adjacent to the old railroad tracks was appreciably above ultimate grade. Therefore, in order to conform to grades and also for the salvage value, the top set of walls of each shaft were removed.

Figure 11 illustrates the manner in which these walls were removed. The crane shown is the same one used to excavate when the shafts were sunk; the clamshell bucket is shown in the foreground. The sewer pipe chimney with ladder extending upward from the roof below is also seen.

It would have been possible to remove the second tier of walls from each shaft, but, due to the sandy nature of the soil, the cave-in would have been excessive, making it unsafe because of the proximity of other underground structures. For this reason only the top tier was removed, the second tier being enclosed in the back fill.

Soon after the completion of the new duct line, new cables were installed in the new line and the feeders and mains cut over to the new cables. The dead cables in the old line were then removed, leaving the old duct line to be demolished by the railroad company's contractor when his excavation progressed to that point.

SUMMARY

The installation described herein shows some of the possibilities and ad-

(*Continued on page* 111)

Plans Completed For Fifth National Accounting Conference

PLANS for the Fifth National Accounting Conference have been completed and the accountants of the gas and electric utility companies may look forward to proceedings of especial value and interest in the sessions to be held at the Netherland Plaza Hotel in Cincinnati on April 7 and 8.

Final details of the program were announced by the joint Planning Committee representing the accounting groups of the American Gas Association and the Edison Electric Institute, sponsors of the conference. E. N. Keller, chairman of the AGA Accounting Section, and G. H. Bourne, chairman of the EEI Accounting Executive Committee, will direct the conference as co-chairmen.

G. H. BOURNE
Chairman, EEI Accounting Executive Committee

Dealing with virtually every phase of utility accounting, the two-day program has been designed to afford practical and particularized help in meeting problems of current importance. The practice of conducting the major part of the discussions in specialized group meetings, which has proved increasingly popular at previous conferences, will be continued and extended this year.

Only topics of concern to all accountants will be presented at the general session on Monday morning, April 7. The contribution the utilities are making in the national defense effort will be the theme of two principal speakers, Major Thomas J. Strickler, president, American Gas Association, and Charles W. Kellogg, president, Edison Electric Institute. The national note will be sounded in the address of Baird Snyder, Deputy Administrator, Wage and Hour Division of the U. S. Department of Labor. Mr. Baird will discuss the coverage of the act in relation to public utilities and will outline exceptions provided in the statute, with reference to the keeping of records. J. Arthur Marvin, C.P.A. partner, F. W. Lafrentz and Company, New York, will discuss the importance to management of internal checks, controls and audits and their relation to the work of the independent certified public accountant.

H. C. BLACKWELL
Host to the Conference

Two general group sessions will be held simultaneously on the morning of Tuesday, April 8, one dealing with customers' activities, and one with general accounting matters. At the customers' activities meeting papers will be presented on these subjects: collecting money and good will; features of a utility's service that are considered arbitrary by customers; proofs employed and statistics compiled in service billing operations, and the relation of deposits to uncollectible accounts. The general accounting subjects will be budgetary control, manuals of procedure, and internal audits, and regulatory problems.

E. N. KELLER
Chairman, AGA Accounting Section

The afternoons of both Monday and

GENERAL INFORMATION

Registration—Register upon arrival to obtain program and badge necessary for admittance to all events. Registration desk on fourth floor, Netherland Plaza Hotel, open on Sunday from 2 p.m. and on Monday and Tuesday from 8:30 a.m. until close of sessions.

Registration Fee—$3.00.

Luncheon Conferences — Tickets for the open luncheon conferences may be obtained opposite the registration desk. Get yours early. Price, $1.50.

Conference Office—Fourth floor, near meeting rooms; open during business hours of the conference.

Hotel Reservations—Make them early direct with the Netherland Plaza Hotel, Cincinnati, Ohio.

Complete Program — Sent upon request by American Gas Association or Edison Electric Institute, 420 Lexington Avenue, New York, N. Y.

Calendar of Events

FIFTH NATIONAL ACCOUNTING CONFERENCE

April 7-8
Netherland Plaza Hotel
Cincinnati, Ohio

SUNDAY — April 6
2:00 P. M. Registration ..... 4th Floor Foyer

MONDAY MORNING—April 7
8:30 A. M. Registration ..... 4th Floor Foyer

10:00 A. M. General Session—All Groups.... Pavillon Caprice

Opening Remarks
Granville H. Bourne, Chairman, Accounting Executive Committee, Edison Electric Institute

Address of Welcome
Hubert C. Blackwell, President, The Cincinnati Gas & Electric Company

Industry's Part in National Defense
Charles W. Kellogg, President, Edison Electric Institute; Major Thomas J. Strickler, President, American Gas Association

Internal Checks, Controls and Audits
J. Arthur Marvin, C.P.A. Partner, F. W. Lafrentz & Company

Gas and Electric Utilities and the Wage and Hour Law
Baird Snyder, Deputy Administrator, Wage and Hour Division, United States Department of Labor

Closing Remarks
Elroy N. Keller, Chairman, Accounting Section, American Gas Association

MONDAY AFTERNOON—April 7
2:00 P. M. Customers' Activities
Credit and Collection ..... Parlor H
Customer Accounting ..... North Hall, East
Customer Relations ..... North Hall, West
Depreciation ..... South Hall
Insurance ..... Parlor E
Materials and Supplies ..... Parlor I
Plant Records—Closed Meeting.. Parlors A-B-C
Taxes—Closed Meeting ..... Parlor F
Uniform System of Accounts—
Natural Gas—Closed Meeting. Parlor J

MONDAY EVENING—April 7
5:00 P. M. Business Meeting—Members only. Parlor D
Managing and Advisory Committees, American Gas Association
6:00 P. M. Business Meeting—Members only. Parlor I
Accounting Executive Committee, Edison Electric Institute

TUESDAY MORNING—April 8
8:30 A. M. Registration ..... 4th Floor Foyer
9:30 A. M. General Session — Customers' Activities—All Groups ..... Pavillon Caprice
General Session — General Accounting—All Groups ..... Hall of Mirrors

TUESDAY NOON—April 8
12:30 P. M. Luncheon Conferences
Customers' Activities
Credit and Collection..... Parlors E-F
Customer Accounting ..... North Hall, West
Customer Relations ..... Parlor G
Depreciation—Closed meeting .. Parlor H
General Accounting — Closed meeting ..... North Hall, East
Taxes—Closed meeting ..... Parlor I

TUESDAY AFTERNOON—April 8
2:00 P. M. Materials and Supplies ..... South Hall
Plant Records ..... Parlors A-B-C

WEDNESDAY MORNING—April 9
9:00 A. M. Local Company Inspection Tours

All Meetings Open to All Delegates Unless Otherwise Noted

Tuesday will be devoted to individual meetings of specialized groups. At many of these meetings authoritative papers will be presented by experts in the particular fields, followed by open discussion in which everyone present will be urged to take part. Other groups will use an informal "round-table" plan, first conducting short discussions on selected subjects along prearranged lines, then turning the meeting into a wide-open forum.

In order that the "swapping" of experience and ideas may be as effective as possible, group leaders are urging accountants to bring their own problems to the sessions and to be prepared to outline their own procedures as a help to their fellows. Several luncheon conferences have been scheduled by various groups. With a few exceptions, the group meetings will be open to all those registered for the conference.

Fewer formal papers are being presented at this year's conference than has obtained in prior meetings. These papers will be made available following the conference but for the most part material presented and the informal discussions of the several committee groups can be had by only those attending.

The Cincinnati Gas and Electric Company will be host to the conference and is making the local arrangements. H. C. Blackwell, president, has invited all the visiting accountants to tour the company's accounting plant on the morning of Wednesday, April 9.

The Cincinnati Company is understood to have done some pioneering work in Property Records and the attention of accounting people, particularly those interested in Plant Accounting Records is directed to the planned tour or inspection of this installation.

The General Session program and the complete Calendar of Events are presented above. Copies of the complete program have been mailed to utility companies. Additional copies may be obtained upon request from the Edison Electric Institute or the American Gas Association, both at 420 Lexington Avenue, New York, N. Y.

Use of Non-Inflammable, Liquid-Filled Transformers is Growing Rapidly, Report Shows

RAPID growth in the use of non-inflammable, liquid-filled transformer equipment is indicated by the latest progress report of the subcommittee studying this type of operation, presented February 17 at the meeting of the Transmission and Distribution Committee at Detroit.

Of 97 utility companies and municipal utility departments replying to a questionnaire circulated by the subcommittee last fall, 50 reported non-inflammable liquid-filled transformer equipment in operation in 1939, the total number of transformers of this type reported in distribution and network operation being 1,119. Three more companies were using equipment built for operation with non-inflammable liquids but at present filled with oil. The totals compare with six transformers of this type, in use by one company, reported for 1932, the year it was first adopted for commercial use. Copies of the questionnaire were sent to 133 utilities, 36 of which did not reply.

M. W. Ghen is chairman of the subcommittee. Members are T. D. Reimers, C. P. Nicholson and P. Boyd.

The following tabulation and the curve sheet indicate the trend in use of this type of equipment since its introduction.

	No. of Transformers		*No. of*
Year	*Network*	*Distribution*	*Companies*
1932	6	..	1
1933	131	..	1
1934	160	1	3
1935	165	1	4
1936	331	13	14
1937	509	49	24
1938	627	99	34
1939	886	233	50

The committee, when sending out the questionnaire, did not deem it advisable to ask each company to furnish data on actual capacity in service at the end of each of the eight years, but was able to secure the number of units in service yearly and the total capacity at the end of 1939. It is believed that the curves indicate quite accurately the growth in use of this type of equipment, and it will be noted that the increase in use of the network type transformer has developed very rapidly since the year 1935. Use of the distribution type of unit, data for which begin to appear in the year 1935, while not approaching in total capacity the amount in use on network systems, seems to be increasing at an increasing amount each year. Total network capacity in service at the end of 1939 was 368,335 kva, represented by 886 units which indicates an average transformer size of approximately 416 kva. The total distribution type capacity in service at the end of 1939 was 55,616 kva, represented by 233 units, indicating an average transformer size of approximately 239 kva.

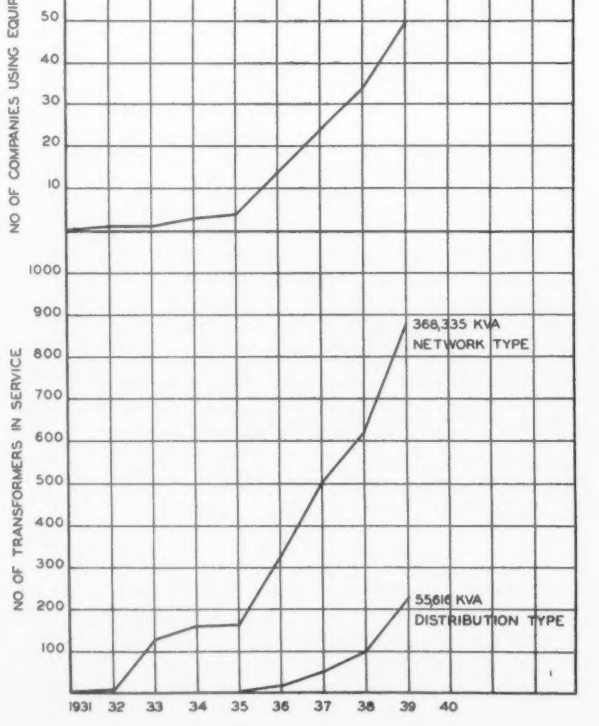
Various reasons are given for the use of this type of equipment, among them being reduced fire hazard, conservation of space, and lower insurance rates. The most general use of the equipment is in vaults located within buildings. In a few companies, non-inflammable liquid-filled transformers are standard for all network vaults.

The operating failure data indicate that quite a number of failures have occurred in the earlier transformer designs, but many of the causes of these failures have been eliminated in the later designs. The most frequent class of failure has been that of the primary winding. Eleven primary winding failures in service and on test have occurred, as well as five terminal chamber failures, nine pothead failures, and eight failures on taped seals on lead cables terminating in the liquid.

Some of these failures have apparently resulted in explosions caused by rupture of the tank, although there is no definite report of secondary explosions having occurred in any case. One case of failure of a taped seal records "vault damage, basement and outside wall of building covered with soot." A second case records "grating blown off manhole, store window broken." A number of cases

(*Continued on page* 96)

GROWTH IN USE OF
NON-INFLAMMABLE LIQUID-FILLED TRANSFORMERS



Adequate Street Lighting Proved a Public Asset in Hartford

By Richard E. Simpson

Consulting Illuminating Engineer, West Hartford, Conn.

IS the true value of adequate street lighting in the everyday community life of the nation generally and thoroughly appreciated, not only by our citizens and their officials, but also by our utility operators? If it were, is it likely that we would see municipal street lighting expenditures on the downward trend, in contrast with the upward trend of other comparable municipal expenditures? And, would municipal street lighting budgets today be about 17 per cent less than they were in 1930, while operators of motor vehicles use 40 per cent more gasoline in their travels and thereby add to the night hazard exposure? I don't believe so.

In this age, one of the principal benefits which can be derived from adequate street lighting by the citizens of any community is protection against excessive night traffic accidents. There are other benefits, but this one can be measured in dollars saved for the community pocketbook, as well as suffering alleviated through decreased injuries and deaths. The opportunity to prove this accident-prevention value of street lighting now knocks at the door of many utility companies. Night traffic accident and death rates abnormally high in numerous cities throughout the United States due largely to inadequate and outmoded street lighting systems. The prospects are that these rates will get worse when the defense program goes into high gear.

Needless to say, adequate street lighting must first be exhibited, or demonstrated, before the benefit of greater night protection can be obtained, and the proof laid bare for the public to examine. Such proof has been made available and publicized in Hartford, Conn., where city officials and engineers of the Hartford Electric Light Company, and the General Electric Company, have been working cooperatively over the past few years in the improvement of the street lighting. A moderate program of improvement was initiated in 1937 when the lighting system was modernized on sections of 14 streets, totaling 10 miles in length. The use of more efficient luminaires, and double the number of units evenly distributed along the streets, resulted in an average illumination of 0.43 lumens per square foot. This is compared with the previous illumination of 0.18 lumens per square foot. The lighting on certain other sections of these 14 streets was not improved. These sections were comparable in length, had the same type and width of pavement, and the same average daily traffic flow as the relighted sections.

Establishment of these two areas, with their contrasting levels of illumination, provided an excellent opportunity for a study of the effect of increased visibility

EDITORIAL NOTE

The following comment on Mr. Simpson's article is by MR. SAMUEL FERGUSON, *president of the Hartford Electric Light Company*

The history of street lighting over the past years indicates generally a lack of planning to meet demonstrated needs. Generally when a new lighting layout is approved under city contract, lamp sizes, spacings, etc., have been specified from an arbitrary formula or according to averages used elsewhere, with only general reference to the specific needs of particular locations. Eventually our city lighting would have similarly suffered, except for the method under which we now work, because with a continuing increase both in numbers of accidents and age of equipment we would certainly have been asked to supply a new layout and probably at one time. This would have meant a major capital expense and the scrapping of far more investment than is required by intelligent and systematic rearrangement of facilities.

(*Continued on Next Page*)

These two pictures show the lighting before and after improvement along a typical Hartford main arterial street. Note the vast improvement in pavement brightness, and increased lighting along the sidewalks.

on night accidents, and in the reduction of their cost to the community. To establish the annual traffic volume by day and night, traffic counts were made on both sections of the 14 streets. Then arrangements were made for a complete recording of the accidents in the two areas. Every motor-vehicle accident involving injury or death, or property damage of $25.00 or more has been recorded for one year before and for a period of three years after the relighting on (1) the relighted streets, and (2) on the unchanged sections of these streets.

In the following table, essential night accidents and other pertinent data are recorded for the two sections of streets.

The reader will note a substantial reduction in night accidents on the relighted streets, compared with a slight reduction in night accidents on the unchanged streets. This latter reduction can be attributed to the general safety campaign conducted by the newspapers and police department. Improvement in traffic control and policing also contributed. While these factors undoubtedly had a similar effect on the relighted streets, the improvement in night visibility conditions can be credited for the

(*Continued on page* 112)

Above and below—Night photographs which show the contrast in visibility conditions on a typical Hartford residential street before and after street lighting improvement.

ADVANTAGES TO THE PUBLIC

Year begins July 1	*14 Relighted Streets*	*Unchanged Sections*
Rate of night accidents per million vehicle miles (1936-37) (Before relighting)	21.30	17.63
Per cent reduction (1937-38) (After relighting)	—49.	— 9.1
Per cent reduction (1938-39) (After relighting)	—68.1	— 9.8
Per cent reduction (1939-40) (After relighting)	—73.2	—13.7
Cost of excess* night accidents (1936-37) (Before relighting)**	$55,275.00	$39,315.00
Cost of excess* night accidents (1937-38) (After relighting)**	18,725.00	39,645.00
Cost of excess* night accidents (1938-39) (After relighting)**	13,416.00	30,787.00
Cost of excess* night accidents (1939-40) (After relighting)**	14,755.00	41,151.00
Increased cost of street lighting (3 years)	$25,500.00	none
Net savings on relighted streets (3 years)	93,429.00	$6,362.00
Annual net savings per mile on relighted streets	3,114.00	212.00

* Excess accidents are those which occur in greater number than are warranted by traffic exposure.
** Property damage and personal injury only.

EDITORIAL NOTE

(*Continued*)

Our present program of city and company cooperation toward better lighting, while not incorporated into any agreement, seems to be working satisfactorily in the interest of all parties. We are spending a goodly portion of the annual revenue from this service in replacement of obsolete lighting equipment. The city, on the other hand, recognizes that it should receive its benefits from improvement in the art through receipt of much more light and safer streets, with a moderate increase rather than reduction in bill.

In consequence, it is easy each year by a study of night accident records on individual streets to plan an appropriate program by which the worst places are scheduled for maximum improvement.

Owing to the improvement in the design of luminaires, great improvement in lighting and accident record has been effected at relatively small increase in city budget, while the company is freeing itself gradually from the obsolescence accumulated during the past years —instead of facing the entire job in some one year when the accident reduction objective could not receive the attention it warrants.

S. Ferguson

Basic Concepts of Property Accounting

By W. A. Paton

Professor of Accounting, University of Michigan

An address before the Fourth National Accounting Conference, AGA-EEI, Detroit, Michigan, December 2-4, 1940

IN accounting we are peculiarly interested in the economic attributes of property as opposed to its physical characteristics; yet there is a tendency in both accounting practice and in the textbooks to stress unduly the aspect of tangibility. Of course, we are all impressed by what the eye can see and the hand hold, but we need to remember that as accountants we are interested in physical facilities primarily because they represent potentialities of economic service. This is one of those commonplace propositions which needs occasional emphasis. The difference between a brick wall and a pile of clay lies in the possibility of the brick wall functioning in an economic sense in a particular setting, and the moment that the wall loses its ability to function its significance becomes precisely that of a pile of baked clay.

This question of physical or tangible versus intangible is just a matter of classification of economic costs. It is convenient and necessary, for administrative and other purposes, to associate cost, as far as this may reasonably be done, with the particular physical layout or setting. We like to wrap up costs, as it were, in terms of physical objects. But it does not follow that there is any material essence in the costs as such. The cost of this stand, the cost of that chair, the cost of a steam generator, or the cost of any other physical asset is simply an accumulation of a bundle of service costs that have been significantly associated with the tangible object at various states of its fabrication and installation.

But not all costs properly incurred in either establishing or operating a business can be readily assigned to particular physical units on a convincing basis. The total cost of the entire property or business may be greater than the sum of the values of the specific tangible objects that make up the physical layout. Some of the costs are applicable to the enterprise as a going concern rather than to individual physical assets.

We have a problem of cost accounting here in the measurement and classification of property value that is very similar to the problem of accounting for factory operations. We do not attach to the cost of a can of beans, for example, all of the charges that are associated with the production of the article, in the broadest sense. As a rule, we attach only those costs more or less directly associated with the stream of physical production, and which are assignable to cost of output on a convincing basis. Some cost systems go much farther than others in this respect, but in almost no case is an attempt made to include all of the fringe of general and administrative costs. We may, for example, omit the president's salary from the assignable costs, on the ground that we are unable to trace satisfactorily the relation of his efforts to the particular unit of product.

I find myself very impatient with the common conception that there is something suspicious or lacking in respectability about organization cost and plant overhead. Such items are just as respectable, and just as significant economically, as any of the other costs incurred in acquiring the property. It is purely a question of classification.

It is true that some of the costs incurred are of such a character that they may not readily be allocated to particular tangible units, but it does not follow that such charges are lacking in validity as a part of the measure of total cost or investment.

In general, moreover, there is no more reason for assuming overstatement in the cost of the services of bankers, lawyers, engineers, accountants, and others who contribute to the work of planning the capital structure, raising the money, and supervising construction, than in the case of the cost of the services of carpenters, plumbers, and others who are associated directly with the physical activities involved.

Another general point which should be borne in mind in considering the nature and significance of property accounting is the relation of such accounting to the measurement of income. Nowadays, it has become popular to emphasize the income approach in dealing with matters of accounting procedure and principle, and I feel that this emphasis, on the whole, is sound. The basic purpose of statistical reckoning in business is the determination of income, and even in the area of plant accounting it may well be urged that other considerations should be subordinated to this primary objective. We do not keep plant accounts just for the sake of having plant accounts, but because plant costs are so important (especially in the utility field) that careful attention must be given to the manner in which such costs are absorbed against periodic revenues in the measurement of net income or loss.

From the point of view of income determination, most would agree, the plant accounts represent primarily costs applicable to future revenues rather than current property values. In other words, the plant account is simply a pool of costs awaiting an appropriate assignment to the output of the business.

Professor Littleton and I, in a recent publication, have tried to emphasize the idea that perhaps the essential purpose of all accounting is the matching of costs and revenues, and that plant accounting is essentially a subdivision of this process.

I realize the limitations of any such point of view. When one thinks of the plant account as a pool of deferred costs, which should be appropriately added to and shaved off, period by period, one is assuming a situation in which there is no marked technological change and in which costs of construction and other price series are relatively stable. In the face of rapid technical development and major price movements the cost and income measurement approach has less appeal.

In the past in the utility field we have been perhaps unduly preoccupied with the view that the primary importance of the property account was in connection with the determination of the rate base rather than the measurement of income. I am pleased to see signs of a growing appreciation of the inadequacy of this view and the need for an emphasis on the absorption of costs incurred in a reasonable, systematic manner.

I would like to give just a little further attention to the subject of property classification.

As a general proposition I submit that we cannot have a plant account that is worth the paper it is written on unless we do have adequate classification, complete and discriminating classification, of the costs of property. Property cost should be subdivided in terms of use, length of life, and other significant characteristics, to facilitate sound administration of facilities and to lay the basis for adequate depreciation accounting. And I see no objection—quite the contrary—to careful segregation of all cost factors which are of such general application that they cannot be spread over the ordinary property accounts without obscuring the significance and usefulness of such accounts.

In public utility accounting in the past, it seems to me, we have had some rather unfortunate classification—classification which has discouraged rather than promoted sound property and depreciation accounting. Take such an account as track and roadway labor, for example. Such an account is not of much value as a permanent element of the property record unless it is broken down in terms of function or use, so as to facilitate careful analysis of maintenance, eliminations, and additions. I might add in this connection that I see no possibility of clear-cut property and depreciation accounting where procedures are determined by such rules regarding betterments and replacements "in kind" as have been so long in effect in steam railway accounting.

Take the "ties" account, for example. Under the controlling rules this account in a few years becomes a hodgepodge which well-nigh defies analysis. It does not represent the cost of original installation of ties, nor does it disclose the cost of the existing layout of ties. The resulting account is neither flesh nor fowl and of little or no use for any purpose.

Ideally, it seems to me, we should have a complete tracing of property cost, in and out. That is, we should follow all charges as incurred and apply them to property accounts appropriately classified, and we should compute and record all eliminations arising in connection with modifications of plant through improvements, reconstruction or other changes.

Now, I appreciate the fact that in the utility field there are special difficulties in the way of carrying out an ideal program of property accounting in which every single charge, large and small, that belongs in the property account goes there in an orderly way, and every single item that should be eliminated, as a result of changing conditions, reconstruction, etc., should be taken out.

In the business represented here we find a plant consisting in considerable part of continuous, integrated structures that are very difficult to classify in detail. The problem is not the relatively simple one of dealing with, say, a flock of motor trucks—separate units—that can be traced and accounted for quite easily. It is perhaps not surprising that in this field there have been developed procedures and rules for handling piecemeal renewals, for example, in a manner which is quite unsatisfactory when judged by the standards which have been developed in the industrial field.

But I do not think it is impossible to do something with the problem, and I think you folks are doing something with it. There has been much constructive discussion of property classification among utility accountants in recent years. I do not suggest that you ought to have distinct property account for each little ear, or whatever you call it, on the telephone pole. On the other hand, to know the cost of each pole actually in use may not be going too far. We all realize, I am sure, that by keeping separate records of yearly installations, by types of property, and by relying upon averaging, the first-in, first-out assumption, and other statistical devices, it is not out of the question to trace the flow in and the flow out of plant charges in such degree of detail as to maintain in the property balances a reasonable approximation of the cost of the facilities actually in use.

I believe that it is technically possible, even in connection with the continuous structures characteristic of utility plant, to work out schemes of accounting classification, and procedure in connection with work orders, which will permit tracing the charges into the accounts quite completely and accurately, and pulling them out again with equal completeness and accuracy.

One of the things that is certainly necessary, if we are going to do a better job of property accounting, is further study of the relationship of depreciation and maintenance. As I see it that relationship is again primarily a question of classification. I find, as I consider this whole problem, that almost all the particular angles I pick up come back to the matter of significant and useful classification. There are two extreme ways of viewing maintenance and depreciation. The chap who defines a utility property as one great integrated mass, one functioning mass, and insists that this is the conception which should control the accounting for property is in effect saying that it does not make any odds whether you have any classification or not. There is, according to his view, one great indivisible property unit, and hence only one general plant account is necessary. From this point of view, depreciation accounting, as a phase of property accounting, practically disappears; all charges associated with operating and renewing the property are "maintenance" costs. All that is necessary is to keep on maintaining the integrated mass of property, and charging the cost of maintenance to operations. Then the property account stands there like the Rock of Gibraltar or the laws of the Medes and Persians and does not need any revision whatsoever as long as there are no additions or outright retirements.

I call this sort of thinking the "fallacy of aggregation." The idea seems to be that a concern with 1000 taxicabs is not bound by the rules that Amos or any other one-cab operator should observe.

You have the same fallacious thinking relative to government operation. In private individual affairs we seem to find that if people run behind all the time, and do not pay their bills, they are very soon "in the soup" and bankrupt, or with no credit standing in the community. But there seems to be an idea on the part of many people that government can go on indefinitely with deficit financing, that if you add a hundred million people together we can justify altogether different behavior from the conduct considered proper in the individual basis.

Similarly, some accountants still seem to feel that if the property is composed of a great multitude of units, of varying ages, we can ignore classification and depreciation accounting, and come out all right, administratively as well as for rate purposes.

I recognize the difference between a specific piece of property and an integrated functioning layout. But I am inclined to think that if you can demonstrate a good procedure for a one-cab business it is unreasonable to assume that altogether different principles obtain for the operation of the 1000-cab concern.

I am tempted to tell a yarn that I have not told for years. If there is any-

body in this room who used to be in my class 25 years ago, he may remember it.

There was a fellow who lived in Michigan, right here in the Detroit area, over where Dearborn is now, and he was a cooper. This chap went out farther west and practiced his vocation. He was a mighty good barrel maker. But he showed up back home finally and when the folks wanted to know why he came back, he said, "Well, I got along fine. The trouble was I was too good a cooper. People began to impose on me. A man would come in for a repair job with a barrel that had the stuffing knocked out of it. Then someone would bring in three or four hoops and a couple of staves and want me to repair the barrel. I stuck with it until one day a fellow brought a bung in and wanted me to repair the barrel, and I quit."

Some of his clients, you see, had altogether too broad a conception of maintenance.

What I am suggesting is that I think that a rather narrow conception of maintenance is the conception that is most useful in the long run in connection with property accounting, and that a whole lot of what we have been calling maintenance in the past ought to have been called depreciation and accrued in a more systematic way as depreciation. But I realize, in saying this, the great difficulty of superimposing on the present utility system any complete change in this direction. And our government friends will do well to remember that we are not starting from scratch. Let us be reasonable about making changes. Let us realize that if we swing toward accrued depreciation the change must be made consistently, and with due regard to the water that has gone under the bridge.

As you can see, from what I have already indicated, I look upon depreciation accounting as not primarily a valuation matter but as a process of assigning plant costs to revenues. That is the interpretation that appeals to me, and always has, and I have had continual argument with my engineering friends on the point ever since I began to have any interest in utility problems.

Moreover, there is nothing mysterious about depreciation, as some seem to think. Depreciation is just an ordinary cost like the other costs. Far from not being an out-of-pocket cost, it is the most out-of-pocket of all costs. You have to build the plant before you can do anything else. If that is not spending money, I do not know what spending money is.

Recognizing depreciation is a process of assigning plant costs to revenue. Technically it has nothing to do with the financing of replacements; it is purely a question of spreading costs already incurred.

However, even if this point of view is accepted it must be admitted that there is plenty of room for argument as to the amount of plant cost already incurred which is assignable to revenue in the particular period. We attempt to account for things in this world every time the earth makes that lonesome trip around the sun. And there is no easy way to demonstrate how much plant cost should be assigned to revenues during one of these journeys.

As far as possible we ought to use simple methods of periodic assignment. Herein lies one of the appealing features of straight-line depreciation procedure. In this connection I am not thinking of the problem of selecting specific depreciation rates. I am just talking about the general scheme or approach that might be adopted.

I rule out the interest methods of spreading depreciation as not being practical, despite their logical force. We will probably continue to putter around with either some variation of the straight-line method, or with what one may call an "output" or an "activity" method.

It would be very easy to go over to the theory that the output scheme of assignment is to be preferred. It is not difficult to think of a machine as simply a bundle of services waiting to be released, and from this point of view one should make charges to operation as the services are requisitioned in accordance with the procedure followed in handling material requisitions. (The process may be less definite but in a way it is true that you requisition the services of a machine just like you requisition materials out of stores.)

The trouble with this approach is that you never can be sure when you throw a tarpaulin over a machine and let it stand idle for a time you will find the same number of requisitionable services when you return the machine to use that you thought it was going to furnish. In other words, the services of a mechanical factor, a good deal like the services of the human factor, tend to disappear and get away from us entirely if they are not utilized according to schedule.

I do not know anything about how depreciation takes place. It may be at the stroke of midnight, or just as the sun goes down, or at some other time. But I am pretty well convinced that the process of expiring economic significance which keeps going on in this world with respect to particular structures cannot be completely arrested just by shutting down. Unfortunately, we can continue to have losses even though we are not actively operating.

I would like to pay my respects to what has been one of the very interesting developments of recent years, the pressure through governmental agencies, in particular, toward a particular interpretation of original cost.

The ordinary accounting point of view, I think you all realize, is not quite consistent with this special interpretation. In industrial accounting, and quite generally throughout accounting, we start accounting processes by first carving out an entity to which to attach our concepts and procedures. That is, we accept the point of view of the particular business. Then we start the work of tracing the costs of the particular business, the costs incurred by the specific entity.

In a situation in which a company constructs its own property, and then goes on for years without change in identity, there is no particular argument about what is meant by original cost. There may be still some argument about what the rate base ought to be and all that, but there is no particular argument about what the cost of the property in legal dollars amounts to, if the construction records were properly kept and the property accounting has followed along in a reasonably satisfactory way since.

Then there is another kind of a situation—one which makes one have a little sympathy with the new point of view. Suppose there is a mere amendment of the entity. The concern was the Delaware Company and now it is the Delaware Corporation. In this type of situation many of us would say that there has not been any substantive change in the entity, the hitching post about which we develop our accounting, and that therefore the cost to this new corporation is simply the cost to the old company.

But now we come to the case where there is a genuine change in ownership, with arm's-length bargaining, if you please, and perhaps the approval of a regulatory authority.

Let us imagine that somebody wants to put his money in the utility business.

(If need be, just stretch your imaginations a little.) He has two ways of doing it. He might build a plant, assuming that proper permission can be secured and all that. He might build a plant at the prevailing level of cost of labor and materials. Or he might buy some existing utility facilities, and if he accepted this second alternative he would presumably pay a price, if the transaction was an ordinary commercial deal, that was in line with the prevailing cost of labor and materials, and with due allowance for the condition of the property.

Take the first case, where our friend builds a new plant. His cost of construction at the prevailing level of prices is the original cost—the original cost under the newer conception, as far as that is concerned. But if he should buy an existing property, taking the thing over completely and getting rid of the other ownership, then—if I understand the new proposal correctly—his cost would not be his cost.

I have been trying to think this matter over in cold-blooded academic fashion, without favor to either side of the current controversy, but I will confess I have had a lot of difficulty in seeing the rhyme or reason in any effort to draw a distinction between these two cases. In one case our friend constructs a steam generating plant, and the prevailing cost of labor and materials becomes his effective cost. In the other case he buys an existing plant, and assuming that it is an ordinary functioning property, the prevailing price of labor and materials will again be a major factor in determining cost or amount invested.

I am afraid we are going to get into some unreasonable situation if we press this particular interpretation of original cost too far. I hold no brief for the writing up of property accounts where there has been a mere amendment of ownership, and I am not unsympathetic to adjustment of property accounts downward where they include discounts and other improper items. But in the case of an impersonal, bona fide, reasonable purchase of existing utility facilities, I see no good reason for attempting to go back to earlier cost data.

All accounting teachers, of course, have taught in their classes that in the event of a genuine acquisition cost for accounting purposes is actual cost to the new owner, regardless of the previous history of the property, or the amount of accrued depreciation on the vendor's books.

When a property is purchased there are two points to be observed. First, what did we pay for the property, on a cash basis? Second, what is a reasonable classification of the cost incurred?

I don't like to see cost to the predecessor company stressed in lieu of cost actually incurred by the concern now operating the property. Should not major changes in economic conditions be recognized at least to the extent that these changes are reflected in changed conditions of investment. Is the public, I wonder, going to insist on adherence to original cost in the restricted meaning employed in the newer classifications? Imagine a period of falling prices and inadequate previous depreciation allowances, and sale of a utility plant at 50 per cent of net book value to an entirely new ownership, perhaps an entirely new plan of operation. In this case are we going to urge retention of the old figures in the accounts, and use of the old data as a basis for rate determinations?

Would it not be much more sensible for us to say, "Why, of course, this property cost just what was paid for it, and from now on that becomes the effective starting point in the reckoning of expenses and income, and the effective starting point in regulation in so far as cost is significant in this area."

I do not conceive of the utility business as a contractual relationship between the public and the company and the regulatory body. It is not a guaranteed business. It is not like an investment in bonds at a contractual rate of interest. It is not that kind of a business at all. You fellows are still in a business with risks. Regulation does not guarantee you any return.

Now, in view of this situation, is it unreasonable to permit the property account to be revised by an actual arm's-length transaction, in the face of new prices and new conditions, even assuming that we are whole-hearted converts of the cost less depreciation approach, even though we say the cost approach is ideal and that the appraisers are out of the picture from now on?

Non-Inflammable Transformers

(*Continued from page* 90)

report "transformers bulged and bolts sheared off."

Inspection interval on these units varies over a wide range, from bi-weekly visual inspection to a complete five-year overhauling. The most frequent practice seems to be a complete annual inspection of the transformers. In most cases, liquid samples are tested at more frequent intervals. The frequency of inspection seems to follow quite closely the practice used for oil-filled network equipment.

The principal causes of difficulty with the transformer liquid have been the presence of moisture in tank and switch compartments and liquid contamination from pothead terminal compounds. No ill effect has been noted where transformers have been operated at or below freezing ambient temperatures.

Considerable data have been secured on operating practices in connection with the use of this equipment and on tests and experiments on the filling liquid, which will be reported to a fuller degree in the final report. Considerable information has been secured on various accessories used with non-inflammable liquid-filled transformer equipment and will be further elaborated on in the final report.

It is the belief of the committee that the data presented in this progress report on the number of units in service and the rapid growth in the use of this type of equipment indicate the desirability of maintaining constant touch with this problem. It is recommended that, following the presentation of the final report on the data as secured from the questionnaires sent to the operating companies, the committee continue to function as an agency to facilitate the preparation of papers and the sponsoring of special studies concerning the operation of this type of equipment, with particular reference to the filling liquid and experience obtained with it as its use extends over the next few years. It is further recommended that a second questionnaire covering the operation of this type of equipment be sent out early in 1942 in order that the operating data for the years 1940 and 1941 may be added to the data thus far obtained.

EEI Files with SEC

THE Edison Electric Institute, in conformity with the decision of its Board of Trustees, made on March 13, has filed the report called for by the Securities and Exchange Commission under the provisions of Section 13 (f) of the Public Utility Act of 1935.

Discussion of Series and Multiple Street Lighting Systems

A report of the Street Lighting Subcommittee,
Transmission and Distribution Committee, E.E.I.

THE lighting of streets and highways is receiving renewed interest by all utilities who supply lighting service, due to the requirements of modern traffic and the availability of improved lighting equipment. Older lighting systems are being modernized and new installations are increasing. The street lighting load is demanding more consideration and attention is focused on the most economical means of supply.

Series street lighting has been the more commonly used system and approximately 90 per cent of all lighting is now supplied from series circuits. Of late years, however, there has been an increasing tendency toward the use of multiple supply and multiple systems have been adopted in both large municipalities and rural areas. Some companies use both systems and do not in all cases keep the two types segregated geographically. There are many items to be considered in selection of the system and it is felt that there is a definite need for a convenient reference available to engineers who are faced with making a choice. The purpose of this report is to present essential facts relating to the construction and operation of series and multiple equipment and the respective merits of the systems, recording as well the essential points which must be included in any thorough economic study.

It is believed that both the multiple and the series systems have definite fields of application, and that in the final analysis, the economics of each specific lighting installation should govern the type selected. The economics should of course be shaded with fine judgment in recognition of various intangibles which defy monetary evaluation, and a bibliography lists sources of discussion on various phases of this subject. Detailed economic studies can only be made for individual systems or installations.

Control

Since streets and highways are lighted from dusk to dawn, the off and on schedules must closely follow the seasonal changes in time. Dependable service attracts little public attention but even an infrequent outage may bring sharp criticism. The importance of continuous service, therefore, justifies careful consideration of the methods of control. Of the several different types of control apparatus in use for series and multiple systems, the more commonly used types will be discussed.

The high inrush current to cold lamp filaments is one of the most important features to be considered when selecting the proper device for multiple light control. For example, the contacts of a 30-ampere relay must be capable of closing the contacts on an inrush current of 420 amperes without welding. In selecting the proper switch or relay for group lamp control the inrush and normal operating currents should be determined. Some companies prefer double contact relays for group control and select an ampere rating which is slightly higher than the combined normal operating current of the lamps to be controlled by that relay.

Satisfactory operation in the laboratory is not always a criterion of successful operation in the field as unexpected failures will develop which will not be detected by the testing in the laboratory. The development of special contact materials affording low resistance and improved non-welding characteristics has been an important factor in the design of multiple lamp control equipment.

Manual

In attended substations, serious circuits are commonly started and cut out by a station operator, although some of the following methods may be utilized even in this case.

Time Switch

To overcome the disadvantages of manual control, time switches with astronomical dials are widely used to control the schedule of street lighting operation. The switch may be operated by a non-carry-over synchronous motor, in which case it is necessary to reset after a service outage, or by a motor wound clock which will continue operating over any reasonable period of interruption. Time switches are available with either plain dials (for fixed time settings) or astronomical dials (for dusk and dawn schedules) or certain combinations of both. They are available for indoor or outdoor use and in some cases are adapted for installation in the base of the street lighting standard where minimum space is a major requirement. Constant-current transformers may be turned on and off by time switches operating through multiple controllers (remote controlled oil switch). With multiple systems one time switch may operate an individual lamp or it may operate a group of lamps by means of a control wire or pilot control circuit, which is discussed later. However, there are several disadvantages in operating a large number of individual time switches. The maintenance and cost of servicing these switches may amount to an appreciable sum. Also the irregularity with which the lamps are turned on and off due to individual control may be objectionable. Time tolerances should be carefully established for satisfactory time-switch operation. Time switches are not adaptable to "black-out" application.

Cascade System

The cascade method of controlling pole or subway type constant current transformers involves the use of a series lighting circuit as a control circuit. An automatic controller with series operating coil is connected in the controlled series circuit and when the parent circuit is energized the controller will cut in the controlled series circuit which is energized from a primary distribution feeder. Likewise, the controlled circuit may operate a controller for a third circuit, etc. The disadvantage of compounding the cascade too many times is that in case of an open circuit in the parent circuit or subsequent circuits, an excessive amount of lighting load may be cut out until the circuit which failed has

been repaired or until the controllers are closed manually.

Around some specific district a series loop may be available which is controlled from an attended substation, or by a time switch. For the control of constant current transformers in outlying districts, controllers with series operating coils can be inserted in this series loop. In this arrangement one controller is inserted in the parent series loop for each local constant current transformer. The advantage of this system over the cascade system is that each local constant current transformer is independent of all except the one parent circuit, although a failure of that circuit will shut down the entire system. Caution should be exercised in designing any cascade system of street lighting to avoid the possibility of extensive interruption to service.

Photoelectric

The photoelectric relay is a comparatively new device, applicable to both series and multiple control in a manner similar to the time switch. Photoelectric control has the outstanding advantage of operating in accordance with natural light intensities, thus turning on lights when they are most needed and turning them off when natural light is sufficient for safety, independent of the time of day.

The simpler types of photoelectric relay must have a spread between the off and on intensities to avoid chattering. This means that the lights must either burn longer in the morning hours than is necessary or be turned on too late at night. Controls have been designed which eliminate this undesirable feature but the expense is much higher.

Pilot Wire

In this system, applicable to multiple lamps, a time switch, photoelectric relay, or other control device is used to energize or de-energize a "pilot wire" rather than a lamp or group of lamps. The pilot wire actuates pilot wire relays located at the individual lamps. In this way a single control is made capable of governing a large number of lamps simultaneously. The relays are described below.

Where a type of distribution is employed which utilizes a grounded neutral, the pilot system for control of multiple lights is particularly adaptable because only one pilot wire is necessary, the grounded neutral being used as the return circuit. On overhead systems this single low voltage pilot wire may be carried on an insulated spool on or near the secondary rack.

There are two common systems of pilot control. The pilot wire may be energized at night to close the relay contacts which supply the lights, or energized in the daytime to hold the relay contacts open. The latter type of control is more desirable, because, should a fault or ground occur on the pilot circuit during the day the lights will come on and trouble crews can make the necessary repairs during daylight hours, and if the trouble develops at night there will be no interruption to the street lights. In laying out a pilot control circuit, it is important to guard against extremely long circuits because voltage conditions may cause sluggish operation of the end relays resulting in burning of contacts and unsuccessful relay operation. One or more control pilots energized from a common bus may emanate from the same station and closely approximate the distribution area served by the station. For outlying districts, pilot control circuits may originate at various points in the field, suitable devices being used to control the operating schedule.

A pilot circuit may be designed to consist of a main trunk energized at a central control location with branches taken off through cascades at various points. A standard relay, controlling a group of lamps is installed on the main trunk near a branch pilot, while a second relay operated from this lamp circuit controls the pilot branch from the local secondary main. By employing this system, a wider area may be covered by one control circuit and a failure in any one branch pilot will not affect the entire circuit. With this method of control the trunk portion of the pilot and the branches are electrically independent from each other and branches are comparatively short, thus greatly reducing the problem of proper voltage conditions at the relay.

Polarized Relay

Still another method of controlling multiple lamps is that known as polarized control. Briefly, this operation requires a station battery or rectifier which is capable of sending out negative and positive impulses over the primary neutral of an insulated 4-wire system. The negative impulse operates the contacts of the sensitive polarized controllers to close the circuit connecting the multiple lamps to the secondary network. To turn the lamps off, a positive impulse is sent over the neutral wire moving the armatures of the controllers in the opposite direction and opening the lamp circuit contacts. This type of control is used by several companies having large multiple lighting systems. For a few isolated sections of multiple lighting the cost of this system may prohibit its use, but if a relatively large system is contemplated this method of control should not be overlooked.

Carrier Current

This system of control utilizes the existing distribution facilities over which the control energy is transmitted from the central substation to operate relays directly connected to the secondary system. A motor generator set at the substation provides high frequency output. The output of the alternator is connected through a series of coupling device at the substation bus and puts sufficient carrier voltage on the feeder to operate the control relays. By using a set of dual high frequency rating, the same substation equipment can be used for the control of water heaters as well as street lights. At any desired point on the secondary network, a tuned control relay responds directly to the control energy transmitted from the high frequency set at the substation. The load contactor operates in accordance with the length of time that the high frequency energy is received. For example, an impulse of 10 seconds will close the load contactor and turn on the lamps and an impulse of 30 seconds will operate the contactor to open the circuit. One frequency may be used for operating the carrier controller to control street lighting and the other frequency to operate the controllers for off-peak water heaters.

The same equipment may be used for remote control of both series and multiple circuits, individually or together. However, a multiple controller must be used in conjunction with the tuned carrier control relay to automatically connect the constant current transformer to the primary distribution circuit. The carrier system is quite flexible in that lights may be turned on or off at any time at will, but it is subject in some cases to extraneous system influences, such as for example, stray frequencies from large rectifiers.

The initial cost of carrier current control is high, since the substation control equipment is costly and the individual lamp controllers are more expensive than time switches. Generally the economics do not permit the scrapping of present street light control apparatus for a new and entirely different type of control. However, if it seems necessary for

any company to revamp its entire lighting system, this type of control should be considered because of its flexibility.

Series Multiple Transformers

Small insulating transformers are available which are capable of supplying specified numbers of multiple lamps from series circuits. The object of this arrangement, namely removal of dangerous voltages from the supply wiring, lamp and luminaire, can usually be served more efficiently by using insulating current transformers and series lamps.

Series Multiple Relays

The series multiple relay is used to control multiple lighting from constant current series lighting circuits. The operating coil of the relay is connected in the high voltage series circuit and when the latter is energized the relay turns on a group of multiple lamps either directly or through a pilot control wire. A new group of lights may be necessary at a particular location at which the series circuit does not have sufficient capacity to supply the increased load, hence a system of multiple lights can be employed and controlled directly from the series circuit through the series multiple relay. Obviously a disadvantage of this practice is that should a fault occur on the series controlled circuit, all dependent multiple circuits will be inoperative and a wide area may be dark until the fault is repaired or the series multiple relays are manually operated.

Pilot Wire Relays

Pilot wire relays are conveniently designated according to the normal contact position with the operating coil de-energized. The normally open relay has its contacts open when the pilot control wire is de-energized, and the normally closed relay has its contacts closed with the pilot de-energized. The latter relay has a wider application because should a fault occur on the pilot control the lamps will come on and advertise a failure which can be cleared up during daylight working hours, as described previously.

Several types of pilot wire relays, employing different means of operation are available. Simple solenoids, thermal elements, mercury tubes, solenoid-mercury plungers and various other combinations are utilized. It is essential to select a relay with a minimum number of moving parts and one whose contacts will withstand everyday usage.

Lightning protection may be necessary for the protection of the relay coil and small arresters are available which can be enclosed within the case of some of the relays.

It is further pointed out that the voltage applied to the relay from the pilot wire circuit should conform closely to the rated voltage of the relay to prevent contact damage from sluggish operation.

Operating Considerations

Although the choice between series and multiple street lighting systems must be a fundamentally economic one, there are several intangible considerations entering into the decision which are difficult to reduce to a monetary equivalent.

These intangibles will be considered briefly before entering into the discussion of economics. Some of the items listed below may be susceptible to economic evaluation in varying degrees.

Series Circuit Features

1. Necessary supervision of current in circuit.
2. Increased precautions necessary against high voltage hazard.
3. Overhead distribution crossarms carry more wires than with multiple lighting.
4. Increased load on series circuit may be expensive to accommodate.
5. Possibility of wholesale lamp outage due to live crosses or lightning.
6. Problem of fault location in series circuits.
7. Telephone influence produced by some series circuits.
8. Superior light concentration and distribution from series lamps.
9. Film cutout troubles occur.
10. Poorer system power factor unless condensers are used in conjunction with constant current transformers.
11. Restoration of street lighting after hurricanes, floods, and other major system disasters is slower due to necessity for rehabilitating an additional electrical system.

Multiple Circuit Features

1. Difficulty in maintaining uniform voltage at all lamps with consequent variation in lumen output.
2. Wider spread of lumen output from multiple lamps during life.
3. Lamp flicker due to motor starting current.
4. If distribution circuits are out, the street lighting is out simultaneously and time switches, if used, must be reset.
5. Damage to equipment if short circuits occur.
6. Greater mechanical complication of multiple control equipment.

The current in the series circuit should be maintained as nearly as possible at the design current of the lamps. With some oil filled constant current transformers there is a tendency for the current to increase gradually for several years due to oil absorption by the windings and it is necessary to take current readings and readjust the balancing weights from time to time to compensate for the absorption. Except for this and the possibility of high or low currents at very light or very heavy loads, the problem of current maintenance in series circuits is relatively simple.

Series circuits operate at higher voltages than multiple, hence must be insulated for dependable operation and for safety. The insulation cannot afford complete protection to employees and the public however. Overhead line wires may come down into the street, and must be de-energized automatically. When this occurs, since the open circuit voltage is even higher than the operating voltage, employees may be momentarily exposed to high voltages at the luminaire while doing lamp work or on the conductors while performing circuit work.

In some instances U.G. series circuits are carried directly up the pole to the fixture and many companies have had entirely satisfactory experience with this type of installation. Other operators consider it necessary to limit the voltage up the pole by the use of insulating transformers mounted in the pole base. This equipment undoubtedly makes for greater safety but adds materially to the cost of the system and introduces additional losses.

If underground fed metal standards are solidly grounded and protective devices are used, the installation is safe and reliable in operation. Linemen are trained to be familiar with the high operating voltage of a series system and to take proper precautions in handling lamp replacements or circuit trouble.

Protective devices are available which disconnect the primary of the constant current transformer in event of open circuits on the lighting loop. Sectionalizing cutouts may be used to disconnect and bypass individual loops in case of an open circuit on the loop. All of these devices add to the safety of the series system and the loop sectionalizing cutout also limits the number of lamps out due to a fault.

Somewhat complicated circuit rearrangements are often necessary to care for additional load on a series system. These may sometimes be simplified by the installation of overhead or underground constant current transformers on the primary distribution lines. Small size constant current transformers are not as economical as larger ones, hence if it is necessary to provide for only a slight increase in load, it is generally worthwhile to rearrange existing circuts to take advantage of spare capacity. The rearrangement of several circuits

to form a new one supplied by a large transformer provides spare capacity over a large area in a most economical manner. However, the placing overhead of constant current transformers in residential areas may be considered objectionable by some companies due to the bulky and conspicuous appearance of the equipment on the pole.

Congested subways may make it impossible to install necessary cable for a new circuit in which case it may be advisable to consider multiple lighting for a portion of the system. This is particularly true in downtown areas where network secondaries of adequate capacity may be already available.

Live crosses with primary distribution or transmission circuits or lightning troubles may cause burnout of strings of series lamps or may cause cutout failures sometimes resulting in lamp outage over considerable areas.

It is not always easy to locate trouble on a series circuit, especially if buried cable is used. This is particularly true of open circuits and some provision is generally made for application of a low voltage test current. Time is required to trace the circuit and a large area may be affected when trouble occurs, although much trouble may be detected by daytime tests and corrected before circuits should be started.

Series circuits sometimes introduce the problem of telephone influence. Vapor lamps may be troublesome if a large number are supplied from a series circuit which parallels an open telephone line for a considerable distance. Similarly, the burnout of lamps supplied by autotransformers or insulating transformers may cause telephone influence if the series circuit containing the open-circuited transformer parallels an open wire telephone line.

For the same lumen output, a series lamp will give about 20 per cent more candle power at angles near the horizontal which are generally considered most useful for street lighting. Due to the higher current passing through series lamps the filaments are more concentrated than those used in multiple lamps, hence the series lamp filament more nearly approaches a point source which enables better light control and offers an advantage in light distribution. This advantage applies particularly to the smaller lamp sizes.

It has been pointed out by some companies, following disaster experience, such as hurricanes, floods, etc., that the series street lighting load must remain

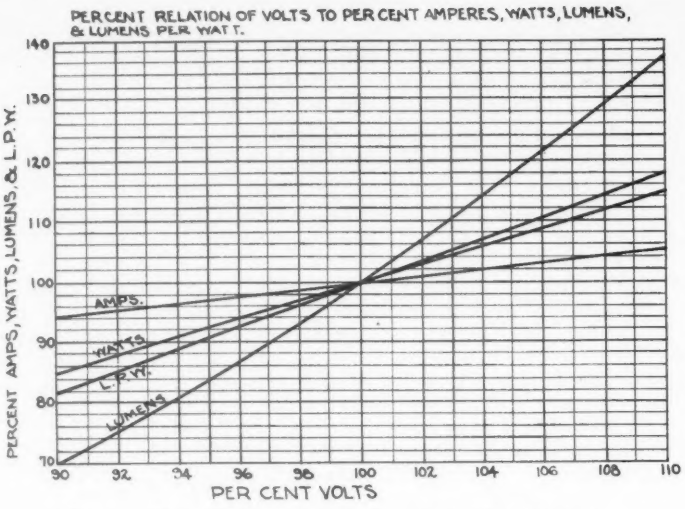


Fig. 1—Characteristic Curves Mazda C Multiple Lamps

largely out of service for the duration of the reconstruction operations on the more important distribution circuits.

Film cutouts or other equivalent devices are necessary in series circuits to short-circuit lamps that fail. Due to their low cost, film cutouts are universally used for this purpose. The simplicity of the cutout renders it somewhat difficult to manufacture within restricted breakdown limits and lamps occasionally suffer outage due to improper cutout operation.

Except for very high intensity service 6.6 ampere equipment is generally standard and lamps up to 10,000 lumens are economical for 6.6 ampere operation. New equipment such as bipost and vapor lamps are designed for this current and it is probably advisable to replace obsolete equipment with 6.6 ampere apparatus. Twenty ampere equipment is available but generally applicable only to compactly arranged installations of high intensity. The high current reduces the series circuit voltage and increases the line losses, but 20 ampere lamps consume less watts than 6.6 ampere lamps of the same lumen rating. It is frequently possible to avoid the use of insulating transformers by adopting a 20 ampere circuit, which may result in a saving in capital expenditure and almost comparable overall losses.

Probably the most important problem in operation of street lighting systems is that of maintaining proper current or voltage at the lamp. Light output is very critical to variations in applied voltage and even more critical to variations in current. Current must constantly be kept as nearly correct as possible in a series circuit and standard equipment does this very well for normal circuit loads. Tolerances of 1 per cent are usually followed. Multiple lights are generally supplied from an existing secondary main, hence, are subject to the voltage variations existing on normal distribution secondaries. The charts (Fig. 1 and 2) show characteristic curves for series and multiple lamps, giving the relation of lumen output to variation of voltage, and lumen output with respect to lamp life for both series and multiple lamps. From the charts it is possible to determine the average lumen output and also the lamp life under variations of energy supply.

From Figs. 1 and 2 it is evident that the lumen output of multiple lamps is only about ½ as sensitive to voltage variations as is the lumen output of series lamps due to current variation. Because of this fortunate fact, the normal variations in distribution voltages are of but little more concern than the normal variations in series circuit currents. Abnormal variations in voltage at individual multiple lamps will, however, produce occasional instances of very bright or dim lamps.

From Fig. 3 it will be seen that the slope of the multiple lamp characteristic is steeper than the series lamp characteristic in each case, denoting a greater spread in light output during life. In most cases this spread is several times greater for the multiple lamp than for the series lamp, and in one case amounts to almost 15 per cent of the light output of the lamp. These discrepancies will be still further increased in cases of over or under voltage ap-

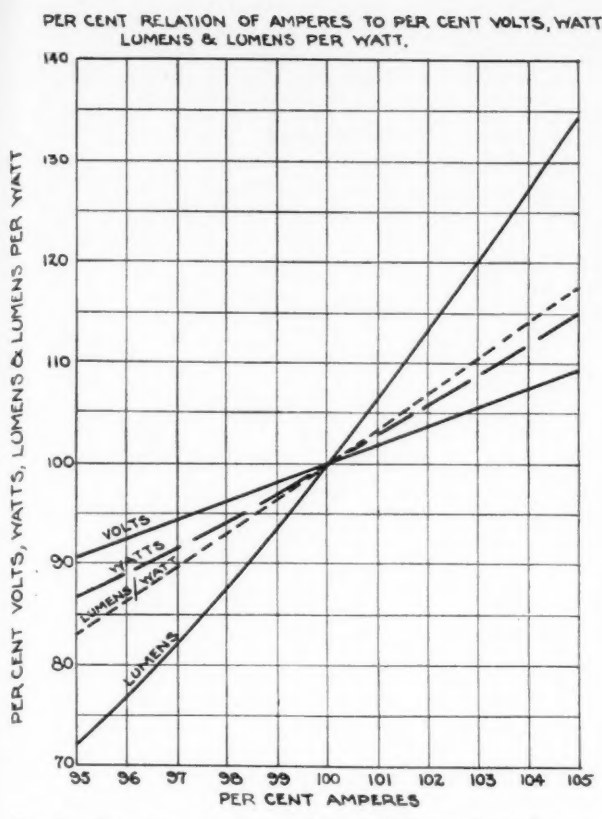

PER CENT RELATION OF AMPERES TO PER CENT VOLTS, WATTS, LUMENS & LUMENS PER WATT.
PER CENT VOLTS, WATTS, LUMENS & LUMENS PER WATT
PER CENT AMPERES
VOLTS
WATTS
LUMENS/WATT
LUMENS

Fig. 2—Characteristic Curves Mazda C Street Series Lamps

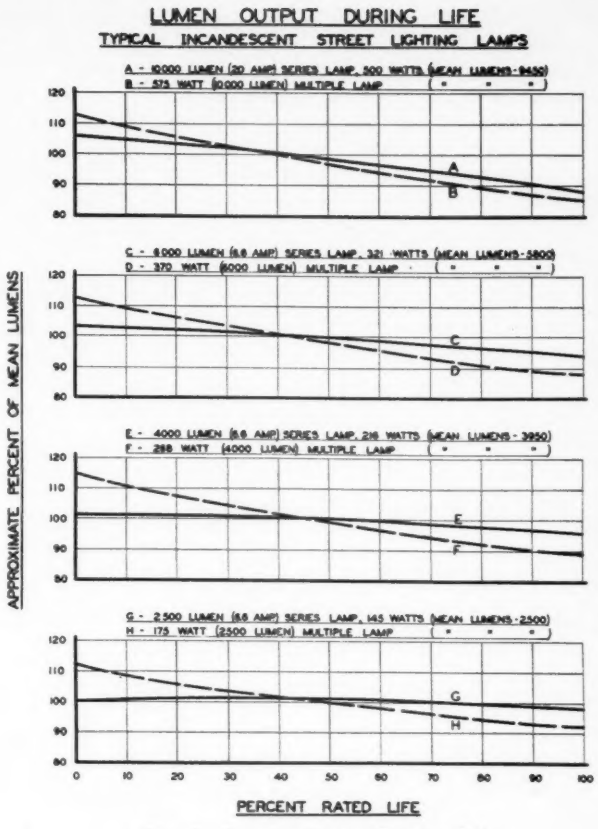

LUMEN OUTPUT DURING LIFE
TYPICAL INCANDESCENT STREET LIGHTING LAMPS
A - 10000 LUMEN (20 AMP) SERIES LAMP, 500 WATTS (MEAN LUMENS - 9450)
B - 575 WATT (10000 LUMEN) MULTIPLE LAMP
C - 6000 LUMEN (6.6 AMP) SERIES LAMP, 321 WATTS (MEAN LUMENS - 5800)
D - 370 WATT (6000 LUMEN) MULTIPLE LAMP
E - 4000 LUMEN (6.6 AMP) SERIES LAMP, 218 WATTS (MEAN LUMENS - 3950)
F - 288 WATT (4000 LUMEN) MULTIPLE LAMP
G - 2500 LUMEN (6.6 AMP) SERIES LAMP, 145 WATTS (MEAN LUMENS - 2500)
H - 175 WATT (2500 LUMEN) MULTIPLE LAMP
APPROXIMATE PERCENT OF MEAN LUMENS
PERCENT RATED LIFE

Fig. 3—Lumen Output During Life

plied to the lamps. However, with the new line of multiple street lighting lamps recently made available, the *average* light outputs of series and multiple systems should not be substantially different, although some of the multiple lamps will be brighter and some dimmer than any of the series lamps at various times in the life cycle of the lamps.

One objection often quoted against multiple lighting is the fact that distribution circuit outage at night also puts out the street lights, thus leaving the affected areas in complete darkness. This condition undoubtedly may produce a motor vehicle accident hazard under certain conditions. To offset this fact it may be mentioned that the breaking of a single wire in a series circuit may put out a large area, whereas a wire failure in a multiple circuit would not usually produce a comparable outage.

There has been some discussion as to the extent of damage to unfused multiple system facilities in the event of short circuits. It is apparent that considerable control apparatus might be affected by short circuits but the operating experiences of some companies indicate that such damage is generally infrequent.

Economics

It has been pointed out that no generalization is possible as to preference between multiple and series systems. The most important factor in making the decision for any particular location is the nature of the existing facilities at the time, plus some consideration of the ultimate lighting requirements for the entire area. New installations usually do not cover an entire city but are limited to certain streets or districts. In one case the presence of existing plant facilities may influence the selection of a series system while in another instance there may be continuous secondary along the streets to be lighted which will favor the multiple system.

In deciding which supply to use for any given location, an economic study is usually necessary. Such a study should include numerous factors, some of which can easily be overlooked unless the engineer has a thorough knowledge of the subject, and it must be considered, after completion, in the light of the various intangibles already discussed.

The economic study is best placed upon an annual cost basis, and includes, in general, fixed charges on the investment, operating costs including energy, and maintenance costs. These are listed in Table I.

Investment Items

Most of the elements included under investments are self-explanatory and uncontroversial. In the case of multiple systems, it is necessary to decide upon a control system and the more common types have been discussed. In dealing with a series system, insulating transformers may or may not be considered necessary depending upon circuit voltage, use of protectors, operating practices, etc.

One item common to all types of systems and which requires some discussion is the matter of distribution charges. There are two approaches to the allocation of distribution charges. The most customary method is to attempt to allocate the cost of that portion of the distribution system which serves the lighting load. Another method which has been recommended is to establish an energy rate for use in the economic studies, which includes a factor to cover the distribution costs. The selection of method can be left to the individual choice of the engineer.

TABLE I

INVESTMENT ITEMS

(Material, labor, transportation, et c., for new and replacement work)

Series	*Multiple*
Constant Current Transformer	Distribution Transformer Charge
Manholes or poles (new or proportional charge)	Control Equipment, including control circuits and relays, if used, with accessories
Control devices and protective equipment	Manholes or poles (new or proportional charge)
Insulating transformers if used	Pole line hardware and insulators
Pole line hardware and insulators	Pole brackets, mast arms, or span wires
Pole brackets, mast arms or span wires	Luminaires and Lamps
Luminaires and lamps including sockets and cutouts	Wire or cable and conduit
Wire or cable and conduit	Riser construction
Riser construction	Lighting standards
Lighting standards	

OPERATING COSTS

(Material, labor, transportation, etc.)

Lamp renewals (individual or group replacement)	Lamp renewals (individual or group replacement)
Energy including circuit losses	Energy including circuit losses
Globe washing	Globe washing
Adjustment and resetting of controls	Adjustment and resetting of controls

MAINTENANCE COSTS

(Material, labor, transportation, etc.)

Lamp and globe renewals (breakage)	Lamp and globe renewals (breakage)
Painting	Painting
Renewal or repair of investment items or parts thereof	Renewal or repair of investment items or parts thereof

In the case of series systems the allocation of distribution charges is a relatively well-defined procedure. Constant current transformers supply street lighting load only, hence their whole installation is chargeable to the lighting system whether they are in substations, on poles or in vaults. Pole charges may be allocated on the basis of proportionate space required for street lighting wires, and subway costs may be pro-rated on the basis of occupancy of conduit and manhole space. It may be necessary to allocate a charge to primary distribution where the constant current transformers are located in outlying parts of the system since the series circuit is dependent upon the primary distribution for energy. It should be noted that the series system involves a certain amount of unused spare capacity due to the impracticability of maintaining all constant current transformers at full load.

In considering multiple systems, the allocation of distribution costs becomes much more complicated and it may be possible to change the aspects of the economic study depending on the line of reasoning followed in establishing these charges. For this reason its importance cannot be over-emphasized. While it is not within the province of this report to discuss development of street lighting rates, it is recommended that the distribution or street lighting engineer discuss the matter of distribution charges with the auditing and rate makng departments.

On most systems, the multiple lighting load operates during the load peak, hence a full proportion of plant costs must be allocated to the street lighting. However, during the summer months, the street lighting load does not operate during the peak load on the distribution transformers or secondary network, and in some territories the character of the winter load may be such that the overlapping peak caused by street lighting load will not equal the summer peak. In this case, full distribution costs should not be allocated to street lighting. Also, with low ambient temperatures in the winter, equipment may be operated at higher ratings without dangerous heating.

Conditions will vary depending upon the type of distribution system facilities. These conditions may be influenced by load density, supply from radial or banked transformers or a network system, size of secondary mains, spacing and size of lamps and voltage to be supplied at the luminaire. The importance of supplying rated voltage to multiple lamps has been previously pointed out.

In some instances, it may be necessary to redesign secondaries or extend separate wires for street lighting and some transformers may have to be replaced. In most systems a demand charge is applied to commercial and industrial rates which represents the investment required to serve the load. It seems only fair that street lighting should bear its share of the investment in accordance with the added peak demand imposed. The complexity of the factors involved can only be pointed out and each company must be guided by accounting and rate making policies.

Operating Costs

Superficially, the problem of lamp renewals seems very simple but a careful investigation brings to light many complexities not apparent at first sight. From the standpoint of the public the light on the street is the most important part of any system, and the lamp is the source of this light. It should be kept burning and appear bright or the utility is liable to official criticism. Manufacturers are making every effort to promote street lighting and are gaining support from civic bodies in every community. Furthermore the efforts in behalf of good lighting are directed toward seeing for safety rather than toward mere ornamental effect. Instruments are available for measuring pavement brightness and it is not fantastic to think of lighting being sold on a lumen output basis. All of this emphasizes the importance of maintaining a full measure of light output at each street lamp.

Lamps may be replaced on the *individual* basis, that is, as they burn out or are broken, or a *group replacement schedule* may be adopted which calls for relamping at fixed intervals shorter than the rated life of the lamp under consideration. If individual replacement is practised, the light output of multiple lamps will vary quite widely depending on the age of the lamp. This is also true for the larger series units. Smaller series lamps will, however, give fairly constant light output until filament welds begin to appear. These welds occur frequently at filament breaks in series lamps of all sizes, and prolong the life of the lamp at substantially reduced light output. If the group replacement plan is followed, there is less lamp outage due to lamp burnouts and the falling off in light output is arrested. Lamps which are used as intermediate replacements may be salvaged in the shop after group replacement is completed, and reused for intermediate replacements. An analysis of group replacement is attached to this report as Appendix I.

The total cost of lamp renewals, including lamps and labor, is affected by

the replacement policy of the individual utility. This policy may vary within the company due to the relative importance of various installations. Group replacement may be practised in some towns where breakage is low and not in other towns having high breakage. Where individual replacement is practiced, the labor charge per year for multiple lamp renewals will be higher than series, due to the shorter life of multiple lamps but, on the other hand, multiple lamps are lower priced than series lamps.

The second operating cost is the energy charge. This is a most difficult charge to establish because it includes a reflection of distribution costs and involves consideration of peak load conditions as previously discussed. In any case, cost of energy should be computed as delivered to that part of the system for which the fixed charges on investment have been considered. This problem has been discussed with engineers and accountants of several large companies but there seems to be no unanimity of opinion which will permit outlining a definite procedure for establishing the energy rate.

If the energy charge for street lighting is considered the same for both series and multiple service, the cost of power will be higher for a multiple system, assuming the use of standard multiple lamps of equivalent mean lumen output to the standard series sizes. Following are listed lumen output and watts for a few typical lamps:

	Watts	
Lumens	*Series Lamps*	*Multiple Lamps*
4,000	216.2	268
6,000	320.9	370
10,000	500.0	575

It is because the watts input is higher for multiple lamps that the cost of energy is a factor in determining the type of system to be used. If autotransformers or insulating transformers are used, transformer losses must be added to the above figures for series lamps, in which case multiple lamps may require less total energy.

The labor and transportation for washing of the street lighting globes and fixtures, are generally considered as operating expenses and should be approximately the same for either a series or multiple system. Overhead charges on labor and material will vary somewhat with the frequency of lamp replacement but will not be greatly different for either type of installation.

Where time switches are used, there is an occasional operating cost involved after an electrical outage for labor and transportation for resetting the switches, provided carryover features are not incorporated in the switches.

Maintenance Costs

The third and final cost element is made up of maintenance charges. These charges cover renewal of broken lamps, renewal of defective parts and painting, including labor, transportation and overhead. They are much the same for either type of system and require little comment.

Series circuits operate at higher voltage and may give trouble due to voltage breakdown of conductors or luminaires unless properly designed and installed. Multiple systems, while operating at low voltage, generally require a large number of control devices which are a potential source of maintenance expense.

It should be remembered that the occurrence of repeated serious troubles in street lighting transformers, luminaires, or control equipment may be so costly as to throw the results of a careful and theoretically correct economic study into an opposite conclusion after the trouble rates have become known.

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APPENDIX I

Economics of Group Lamp Replacement

Factors to be Considered

Several types of lamps for street lighting service are listed by the manufacturers. Both series and multiple lamps may be obtained which have a relatively short life attended by a relatively high efficiency, or which have a longer life and correspondingly lower efficiency. The multiple lamps may be obtained in various voltage ratings. Replacements may be made individually as lamps burn out or in groups after a specified interval of burning. In determining the most economical replacement procedure several factors must be considered, as follows:

1. Whether or not the group replacement method is economical for each size of series and multiple lamp.
2. The life of the lamps to be used.
3. The proper voltage rating for multiple lamps.

The first two factors may be considered simultaneously by tabulating the maintenance and operating costs under individual replacement of all available lamps, then determining by methods given below the saving, if any, under group replacement. The calculations may be simplified in some cases if all multiple lamps which give inadequate light output are eliminated. In general, the average system voltage at the multiple street lamp socket should be determined and the lumens, life and watts of the multiple lamps having the nearest voltage rating should be computed for this service voltage. Knowing the minimum lumens that are desired at any location, it is then possible to determine the most economical manner of obtaining them. The third factor listed above is thereby taken into account.

In cases where operating costs favor individual replacement, consideration should be given to the fact that group replacement reduces outage due to burnouts and maintains a higher level of illumination by removing blackened and welded lamps from service. Where the cost margin against group replacement is not great, these considerations will often have enough weight to shift the decision.

It should not be assumed because the longer-lived lamps for street lighting service are called the "group replacement line" and the shorter-lived lamps are called the "standard line," that the 3000 hour lamps should never be individually replaced, nor that the 1500 or 2000 hour lamps should never be group replaced. The best practice cannot be positively

determined until calculations have been made for every condition. Under certain conditions, such as areas where lamps are thinly scattered, individual replacement of group replacement type lamps may prove to be the best practice.

Data Required

Although a complete mathematical analysis cannot be given in the space allotted to this Appendix, it is possible to list the items which are required for a cost study and to give their derivation. A table can be prepared having a sufficient number of vertical columns to provide for entries of data under headings for group replacement and standard types of each size of series and multiple lamps on the system in question. The following items may be included in each vertical column heading:

1. Series lamp lumens and amperes, or multiple lamp watts (and volts if necessary).
2. Lamp type (i.e. standard or group replacement).
3. Number of installations on the system.
4. Thousands of lamp-hours burning per year.
5. Average rated laboratory life in hours. (In the case of multiple lamps, this item should be the laboratory life at the average system socket voltage at which the lamps are to operate.)
6. Total lamps missing and broken per year.
7. "Bh" (Item 6 x item 5 ÷ item 4.)
8. "c" (Cost of one lamp in dollars, including cost of purchasing and warehousing, but not including cost of installation in socket).
9. "g" (Cost in dollars of installation of one lamp in its socket when such installations are made in groups).
10. "i" (Cost in dollars of installation of one lamp in its socket when such installations are made individually as failures occur).
11. "c/c + i" (Derived from items 8, 9 and 10 by
12. "c + g/c + i" (calculation or by nomographic charts).
13. "z" (Most economical interval between group replacements expressed as a fraction of average rated laboratory life. May be obtained from Fig. 4 when $\frac{c}{c+i}$ and $\frac{c+g}{c+i}$ have been determined).
14. "$1 - P_g/P_i$" (Proportionate saving effected by group replacement of lamps at the most economical intervals. May be obtained from Fig. 5 when $\frac{c}{c+i}$, z and Bh have been determined).
15. Lamps required per year under individual replacement. This can be shown to be equal to item 4 ÷ item 5 + ½ item 6.
16. Maintenance cost in dollars per year under individual replacement. (Item 15 x (c + i).)
17. Maintenance cost in dollars per year under group replacement. ((1 — item 14) x item 16.)
18. Kilowatts required per lamp. (From manufacturers' design data plus loss in autotransformer or compensator, if any.)
19. Thousands of kilowatthours per year. (Item 4 x item 18.)
20. Energy cost, dollars per year. (Item 19 x assumed cost of energy in dollars per 1000 kwhr.)
21. Operating cost in dollars per year. (Item 16 or 17 plus item 20.)
22. Operating cost in dollars per year per lamp. (Item 21 ÷ item 3.)

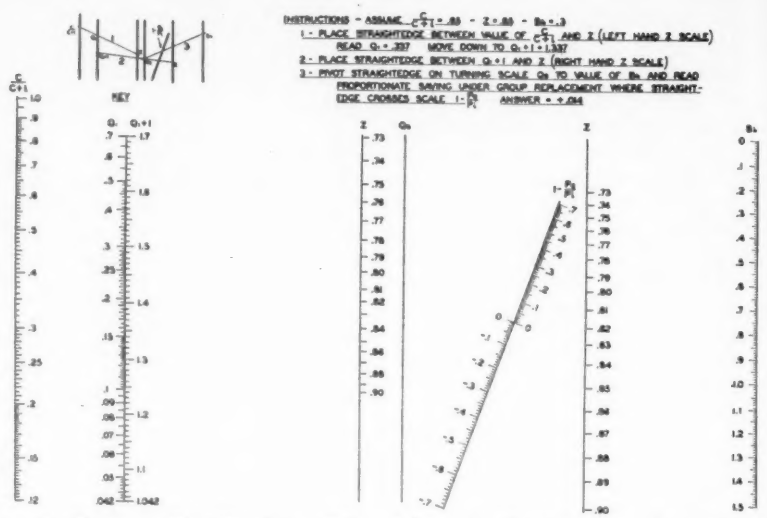

INSTRUCTIONS - ASSUME c/c+i = .85 - z = .86 - Bh = .3
1 - PLACE STRAIGHTEDGE BETWEEN VALUE OF c/c+i AND Z (LEFT HAND Z SCALE)
READ Qo = .337 MOVE DOWN TO Qo+i = 1.337
2 - PLACE STRAIGHTEDGE BETWEEN Qo+i AND Z (RIGHT HAND Z SCALE)
3 - PIVOT STRAIGHTEDGE ON TURNING SCALE Qo TO VALUE OF Bh AND READ PROPORTIONATE SAVING UNDER GROUP REPLACEMENT WHERE STRAIGHTEDGE CROSSES SCALE 1-Pg/Pi ANSWER = .034
KEY
c/c+i
Qo
Qo+i
z
Bh

Fig. 5—Nomographic Chart for Determining the Proportionate Saving Under Group Replacement

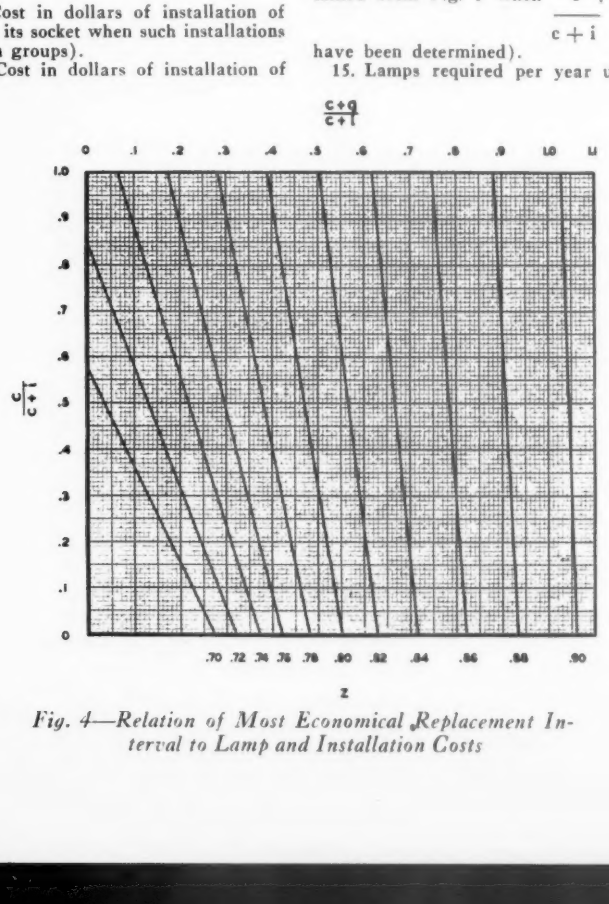


Fig. 4—Relation of Most Economical Replacement Interval to Lamp and Installation Costs

Discussion

The results of the above calculations depend, naturally, upon the accuracy of the assumptions upon which they are based. Figs. 4 and 5 are based on equations derived in Electrical Testing Laboratories Report No. 5269, but modified on the assumption that (a) lamps removed on group replacement are salvaged and (b) those which appear to have burned less than half their lives are re-used for intermediate replacements.

The values of g and i are fundamental in the calculations and must be accurately determined. Large lamps may be most economically group replaced if globes are washed at the time of lamp replacement. The cost should be allocated in accordance with the relative importance of the two operations. In some cases it may not be possible to justify group replacement unless globe washing absorbs the major portion of the total cost.

Control of Kite Flying Hazards

By George S. Diehl

Vice-Chairman, Accident Prevention Committee, E. E. I.

THE hazards incident to flying kites near electric light and power lines have given the Accident Prevention Committee concern for a number of years because of the fatal accidents and injury to children. Manufacturers of kites have been approached through the National Safety Council with the request that they do not manufacture kites with wire or conductive material for integral parts. Suggestions have been made that kites carry safety instructions printed on the kite. Many utility companies (one for 15 years) have been conducting intensive educational campaigns through bulletins, posters, newspapers, radio, parent-teachers associations, boys organizations and the like, calling attention to the hazards incident to kite flying.

The only factual accident information available was an occasional newspaper clipping reporting death or injury to some boy due to his kite or string becoming entangled in electric wires.

In order to get more information on these accidents and the general nuisance caused utility companies by reason of kites and strings becoming entangled in these lines, a questionnaire was addressed to the members of the Accident Prevention and the Transmission and Distribution Committees. Seventy-one questionnaires were sent out; 44 replies have been received to date. The interest and response to this questionnaire have been gratifying to the Committee. Copies of the data have been filed at E. E. I. Headquarters with the secretary of the Acciden Prevention Committee for future reference.

The summary of the replies, which does not include the entire industry, indicates that eight boys have been killed and 36 injured in various degrees. Service to the public has been interrupted for periods varying from minutes to hours. Lines have been burned down varying from 2300 volts to 110,000 volts. Wire and tinseled cord has been involved in the troubles reported by 36 companies. Pre-arranged outages of distribution and transmission circuits of voltages from 4000 volts to 220,000 volts have been necessary in order to remove the remains of kites and kite strings from the lines. Hot line tools are used by some companies for this purpose. One company reports that the remains of 770 kites and strings are removed from its lines annually, and another reports that about 150 kites and strings are removed from its lines weekly during the peak of kite flying season. The above summary of the fatalities, injuries and trouble is not complete but it does point out the magnitude of the problem, and gives a good cross-section of the experiences throughout the United States.

Intensive educational programs are conducted annually by many companies through schools, boy and girl organizations and parent-teacher organizations, consisting of lectures, leaflets, bulletins and posters. In some localities the police departments give full cooperation in these efforts to discourage the flying of kites near electric wires. Newspaper items, paid publicity and radio programs have been effective in reducing kite accidents. Some companies print their names on posters and bulletins; others prefer not to do so. Local Safety Councils, in addition to the National Safety Council, and Boy Scouts have been helpful in educational campaigns and the distribution of literature. When kite flying contests are conducted it is desirable to advise the sponsor of the hazards and supply him with safe kite flying information.

The information obtained from the survey shows clearly the necessity for all such educational campaigns being continued and emphasizes the importance of similar work being promoted in any areas where it is not carried on. These campaigns will be made more effective if they receive the full support of school boards and the local police departments. Efforts to obtain full support from the manufacturers and vendors of kite supplies to eliminate kites containing wire and the use of fine wire or tinseled cords should be continued.

In addition to the above methods of attacking this problem, suggestions were received recommending greater publicity by the National Safety Council and that the American Red Cross include both the hazards incident to kite flying, and safe kite flying recommendations in its literature on farm and home safety. One company recommended a good moving picture showing what happens when a kite becomes entangled in electric wires and how to avoid such a situation.

From a national standpoint the National Safety Council is the logical central organization to direct such educational activities and has prepared posters and literature on the subject. However, the Accident Prevention Committee of the E. E. I. is desirous of assisting the Council in its endeavors to bring the hazards of kite flying more forcibly to the attention of the public in general and to school children in particular and directs attention to the contribution that can be made by local light and power companies through the use of appropriate educational means.

The following program is, therefore, recommended by the Accident Prevention Committee as one which, if consistently carried out by all Institute member companies through their safety or public relations departments, should result in a better understanding of the seriousness of this kite flying problem and bring still further reduction in this hazard to life and property and the service of utility companies.

1—Solicit the aid of newspapers in all communities in a continuing effort toward constructive publicity on the subject.

2—Develop and carry on a program by which the school children and all young people's organizations can be instructed through motion pictures, posters and literature on safe kite flying.

3—Include safe kite flying in radio programs for children.

4—Get the cooperation of the school commission, teachers and parent-teachers associations.

5—Bring the hazards to the attention of the kite manufacturers and urge their cooperation.

6—If possible, induce department and toy stores to join the crusade for safe kite flying.

7—Inform sponsors of all kite flying contests of the hazards involved, and supply them with safe kite flying information.

Free Offer

The Modern Kitchen Bureau's Electric Water Heater Program features a recording of 16 one-minute radio programs that promote electric water heating convenience with songs, dramatic skits and selling copy. This new departure in water heater merchandising has been enthusiastically received by the industry. The letters below, from all points of the compass, are typical of comments received from utility men.

Recordings will be sent without charge on trial to those utility executives who would like to hear them. The price of the recording is $2.50.

NORTH

Fred E. Eriksen, Advertising Manager, Wisconsin Electric Power Company, Milwaukee, Wis., writes: "I feel the continuity comes closest to actual home thinking and feeling than any water heater copy I have heard or read . . . these one-minute spot announcements will prove very effective."

EAST

G. C. King, Sales Manager, Brockton Edison Company, Brockton, Mass., writes: "With the Bureau's aid there is now available professional talent at a price we can afford. We expect it to be a material aid to us in attaining our 1941 electric water heater quota."

WEST

A. C. McMicken, General Sales Manager, Portland General Electric Company, Portland, Oregon, writes: "We are particularly delighted with the jingles set to music . . . I vote 100% for these spot announcements and assure you that we will use them to the greatest extent possible in this territory."

SOUTH

H. E. Cox, Vice President, Birmingham Electric Company, Birmingham, Ala., writes: "We plan to use these recorded announcements over our three local radio stations . . . these programs are unusually well dramatized and attention-arresting."

Write the Bureau today for a trial hearing.

Four Plans

While The Modern Kitchen Bureau's Electric Range Program is based upon a Round-Up of men's favorite recipes, there is no need to sponsor a cooking school or contest in order to take advantage of this promotion.

Four plans, explained below and in the Plan Book, offer utility companies their choice of four promotions, one of which will fit their merchandising policies. Sales material offered by the Bureau has been designed to work effectively on all plans.

The flexibility of this Range Program has proved highly popular.

PLAN 1

This plan provides for a Record Year Spring Showing of electric ranges, a distribution of the "Famous Recipes by Famous Men" booklet and a Round-Up of recipes from He-Man Cooks, with each recipe entrant being awarded a diploma certifying his ability.

PLAN 2

This plan is designed for companies who do not wish to conduct a local Round-Up of recipes, but want to take advantage of other features described in Plan 1. All the material can be used with the exception of announcements regarding the local Round-Up.

PLAN 3

This plan contains all features of Plan 1, plus Cooking School demonstrations not only of the recipes included in the "Famous Recipes" booklet, but also of those submitted by local entrants in the Round-Up.

PLAN 4

This plan includes one more feature, the crowning of the King of the He-Man Cooks in the company's territory. The best recipe submitted wins the prize. This plan, together with Plan 3, offers extensive publicity possibilities.

Write the Modern Kitchen Bureau today for your Plan Book

DOUBLE-FEATURE
LOOK, IT'S ROUND-UP OF HE-MAN Recipes
...AND ELECTRIC RANGE Record Year SPRING SHOWING
Free
BOOKLET OF RECIPES MEN LIKE by these CELEBRATED HE-MAN COOKS
and many others
GET YOUR COPY DURING ELECTRIC RANGE Record Year SPRING SHOWING

Farm Electrification Increases; Number of Farms Decline

THE adjoining table, graphically illustrated by the map, shows the change in the number of farms during the decade 1930 to 1940 and the number and percentage of electrified farms of both years. The estimated number of electrified farms as of December 31, 1940, was 1,988,361 as compared with 640,919 for the same date in 1930, an increase of 206 per cent during the ten-year period.

The 1940 number of farms is based on preliminary data released on the U. S. Census of Agriculture for 1940. The electrification figures comprise data collected by the Edison Electric Institute, the percentage figures being based on "number of farms" and not on "farms with occupied dwellings," as formerly reported.

During the ten-year period a reduction of 3.1 per cent in the number of farms was paralleled by a 7.5 per cent increase in the *area of land* in farms and a decline of 29.7 per cent in the value of land and buildings, as shown by the following:

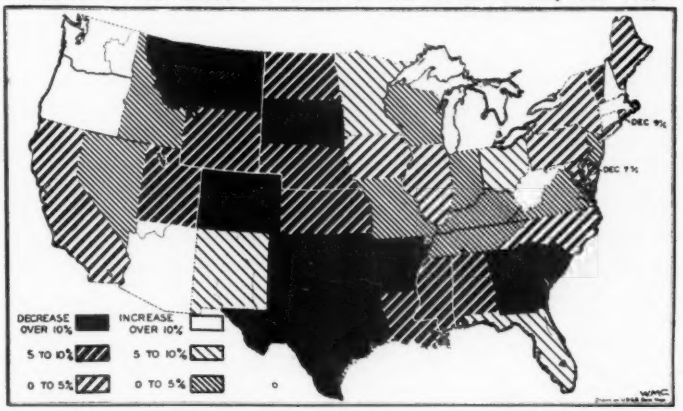
Total U.S.A.	*1940*	*1930*	*Change %*
Number of farms	6,096,789	6,288,648	—3.1
Land in farms (sq. miles)	1,657,147	1,541,828	+7.5
Value land & buildings	$33,644,263,247	$47,879,838,358	—29.7

Compared with the Census of 1935, the reduction in the number of farms was even more drastic. During the worst part of the depression, from 1930 to 1935, there was a "return to the land" on the part of the idle industrial workers, which resulted in an apparent increase of 523,702 farms, or 8.4 per cent. From 1935 to 1940 there was a decrease of 715,561, or 10.5 per cent, leaving a net loss for the decade of 191,-859. For the decade as a whole, the largest percentage decrease in the number of farms occurred in the West South Central States—Arkansas, Louisiana, Oklahoma and Texas.

The largest percentage increase was in Massachusetts, Connecticut and Arizona.

	1940 Data				1930 Data		
	Number of Farms on Apr 1, 1940	Est. Number Elec. on Dec 31, 1940	% Elec.	Number Elec. in 1940	Number of Farms on Apr 1, 1930	Number Elec. on Dec 31, 1930	% Elec.
United States	6,096,789	1,988,361	32.6%	286,688	6,288,648	649,919	10.3%
Maine	38,980	19,647	50.4	853	39,006	12,001	30.8
New Hampshire	16,554	11,084	67.0	784	14,806	5,658	38.0
Vermont	23,582	10,437	44.3	911	24,898	6,986	28.1
Massachusetts	31,897	23,610	74.0	710	25,598	14,086	55.0
Rhode Island	3,014	3,000	99.5	-	3,322	1,811	54.5
Connecticut	21,163	18,500	87.4	1,200	17,195	8,452	49.2
New England	135,190	88,278	65.8	4,458	124,925	48,996	39.2
New York	153,238	107,301	70.0	5,857	159,806	47,147	29.5
New Jersey	25,835	21,784	84.3	624	25,378	11,212	44.2
Pennsylvania	169,027	120,715	71.4	10,585	172,419	37,983	22.0
Middle Atlantic	348,100	249,800	71.8	16,846	357,603	96,342	26.9
Ohio	233,783	150,738	64.5	15,749	219,296	43,242	19.7
Indiana	184,549	99,276	53.8	18,970	181,570	20,503	11.3
Illinois	213,439	97,453	45.7	22,076	214,497	22,699	10.6
Michigan	187,589	132,393	70.6	8,698	169,372	29,869	17.6
Wisconsin	186,735	83,659	44.8	7,765	181,767	34,800	19.1
East No Central	1,006,095	563,519	56.0	73,258	966,502	151,113	15.6
Minnesota	197,351	46,435	23.5	9,142	185,255	13,121	7.1
Iowa	213,318	73,584	34.5	15,242	214,928	29,634	13.8
Missouri	256,100	55,315	21.6	14,237	255,940	14,418	5.6
North Dakota	73,897	6,090	8.2	1,574	77,975	1,711	2.2
South Dakota	72,454	4,562	6.3	760	83,157	2,846	3.4
Nebraska	121,062	24,254	20.0	4,763	129,458	8,960	6.9
Kansas	156,327	28,043	17.9	4,966	166,042	11,583	7.0
West No Central	1,090,509	238,283	21.9	50,684	1,112,755	82,283	7.4
Delaware	8,994	5,024	55.9	728	9,707	1,163	12.0
Maryland Dist. of Col.	42,175	19,376	45.9	1,374	43,203	6,614	15.3
					104	66	63.5
Virginia	174,887	42,312	24.2	5,971	170,610	10,105	5.9
West Virginia	99,282	24,875	25.1	3,389	82,841	2,891	3.5
North Carolina	278,276	63,166	22.7	12,048	279,708	9,450	3.4
South Carolina	137,558	31,717	23.1	9,343	157,931	3,493	2.2
Georgia	216,033	53,826	24.9	11,901	255,598	4,372	1.7
Florida	62,245	14,710	23.6	1,809	58,966	4,365	7.4
South Atlantic	1,019,450	255,006	25.0	46,563	1,058,468	42,539	4.0
Kentucky	252,894	33,554	13.3	7,673	246,499	6,815	2.8
Tennessee	247,617	42,334	17.1	9,459	245,657	7,585	3.1
Alabama	231,801	45,985	19.8	11,480	257,395	12,001	4.7
Mississippi	291,092	31,070	10.7	9,061	312,663	3,548	1.1
East So Central	1,023,404	152,883	14.9	37,673	1,082,214	29,949	2.8
Arkansas	216,674	19,874	9.2	5,552	242,334	3,202	1.3
Louisiana	150,007	14,294	9.5	2,513	161,445	2,218	1.4
Oklahoma	179,687	23,137	12.9	4,749	203,866	4,517	2.2
Texas	418,002	71,935	17.2	18,290	495,489	11,501	2.3
West So Central	964,370	129,240	13.4	31,104	1,103,134	21,438	1.9
Montana	41,823	6,600	15.8	1,425	47,495	2,192	4.6
Idaho	43,663	27,938	64.0	4,235	41,674	12,126	29.1
Wyoming	15,018	4,039	26.9	1,124	16,011	476	3.0
Colorado	51,436	17,770	34.5	3,144	59,956	6,757	11.3
New Mexico	34,105	3,475	10.2	541	31,404	1,242	4.0
Arizona	18,468	8,301	44.9	454	14,173	3,805	26.8
Utah	25,411	20,222	79.6	1,349	27,159	15,082	55.5
Nevada	3,573	1,680	47.1	98	3,442	876	25.5
Mountain	233,497	90,035	38.6	12,370	241,314	42,536	17.6
Washington	81,686	58,718	71.9	4,701	70,904	33,803	47.7
Oregon	61,829	38,850	62.8	3,492	55,153	15,767	28.6
California	132,659	125,749	94.8	5,539	135,676	85,153	62.8
Pacific	276,174	223,317	80.9	13,732	261,733	134,723	51.5

CHANGES IN THE NUMBER OF FARMS IN THE UNITED STATES, 1930–1940



Federal Liquor and Tobacco Taxes vs. Cost of Electricity

FOR the calendar year 1940, the following taxes were collected by the U. S. Bureau of Internal Revenue:

On Distilled spirits	$371,146,464	
Fermented malt liquors	286,126,594	
Other liquor taxes	63,751,995	
Total liquor taxes		$721,025,053
On Cigars	13,130,337	
Cigarettes	564,816,535	
Other tobacco taxes	67,562,999	
Total tobacco taxes		645,509,871
Total Federal Taxes on Liquor and Tobacco		$1,366,534,924

In contrast, total payments for domestic electric service in 1940 were $885,-900,000.

Charles A. Stone

CHARLES A. STONE, co-founder and chairman of the board of Stone and Webster, Inc., died February 25 at his home in New York City. He was 74 years old.

A graduate of the pioneer course in electrical engineering at Massachusetts Institute of Technology, Mr. Stone entered the infant electric industry in 1889. With a classmate, Edwin S. Webster, he established the Massachusetts Electrical Engineering Company, Stone and Webster, Managers. It was a partnership which was to have a long and important influence upon the utility industry and in engineering and construction of many types. The firm's first undertaking was the construction of the Saccarappa, Me., hydroelectric installation and transmission line, which demonstrated the commercial possibilities of electrical power transmission. During the period of reorganization following the panic of 1893, Stone and Webster were asked to assume management of electric light and power plants and electric railways. Later they also took over gas plants, water systems, central steam heating plants and bus companies. About the turn of the century they began financing some of these companies and thus entered the general investment banking field. These functions have been carried on since 1927 by the firm of Stone and Webster and Blodget, Inc.

In 1916 Mr. Stone became president of American International Corporation, which acquired extensive interests in foreign undertakings. He continued in this post until after the World War. In 1925 he arranged the purchase of the Virginia Electric and Power Company and, with it as a nucleus, formed Engineers Public Service Company, of which he was chairman for several years. At the time of its golden anniversary in 1939, the firm of Stone and Webster was supervising utilities whose annual gross earnings were more than $64,000,000.

Mr. Stone had served as a director of the Federal Reserve Bank of New York, International Mercantile Marine Company, International Acceptance Bank, Inc., Bank of the Manhattan Company, North American Company, First National Bank of Boston, Research Corporation and Union Pacific Railroad. He was for many years a member of the executive committee of Massachusetts Institute of Technology. He was born in Newton, Mass.

Jesse H. Pevear

JESSE H. PEVEAR, chairman of the board of Birmingham (Ala.) Electric Company, died March 6 at Birmingham. He was 63 years old.

Mr. Pevear, who was prominent for many years in the industrial development of the South, retired as active head of Birmingham Electric in 1939 because of ill health. He went to Birmingham in 1915 as president of the old Birmingham Railway, Light and Power Company. Before that, he served as president of New Orleans Railway and Light Company and president of United Gas and Electrical Engineering Corporation, New York, and worked with utility companies in St. Paul and Buffalo. Born in Lynn, Mass., he graduated from Brown University in 1899 and later studied law at Harvard.

Frank T. Post

FRANK T. POST, former president of Washington Water Power Company and for over half a century prominent in the civic affairs of Spokane, died March 5 at the age of 78. He had been ill for several weeks.

Mr. Post went to Spokane from his native state of New York in 1889. After conducting a private law practice for several years, he became president and general counsel of Home Telephone Company and served in that capacity until the firm was bought by Pacific Telephone and Telegraph Company. He first became associated with Washington Water Power Company in 1909 as general counsel. When the company was taken over by American Power and Light Company he was active in the negotiations and later was elected vice-president. He succeeded the late D. L. Huntington as president, resigning the position in 1938 to become chairman and consultant. Although he retired from the chairmanship in 1940, he retained an office in the company's general office building and was actively interested in its affairs until shortly before his death.

A thoroughgoing individualist and a picturesque character always, Mr. Post was a one-man institution in Spokane. He was regarded as one of the outstanding attorneys in civil law in the West. Before his affiliation with Washington Water Power, he served a year as corporation counsel of the City of Spokane, and he was a past-president of both the Spokane County and Washington State bar associations.

Mr. Post was born at West Potsdam, N. Y., in 1862. Upon graduation from St. Lawrence University in 1883, he entered a law office at Canton, N. Y., as a student, and later studied for one year at Harvard Law School. He formed a law partnership and opened an office in Lowville, N. Y., in 1886. He went West three years later upon the advice of a doctor.

Resolution on the late Charles B. Scott

THE death of Charles B. Scott on Jan. 19, 1941, was announced to the Accident Prevention Committee at its meeting on Feb. 10 and 11 at Roanoke, Va., and in accordance with the action of the committee, the following resolution has been drawn:

WHEREAS, through his association with accident prevention work in the electric light and power industry Charles B. Scott rendered valuable service in his capacities first as Secretary, from 1913 to 1919, and later as Chairman, from 1919 to 1925, of the Accident Prevention Committee of the former National Electric Light Association, and

WHEREAS, through his interest in the prevention of accidents and consequent suffering, he advanced the welfare and security of employees of all electric light and power companies, and

WHEREAS this contribution was the more significant because of his understanding, vision and confidence in what could be accomplished through cooperative effort, and

WHEREAS in all of his contacts with his associates he evidenced qualities of integrity, sympathy, good-fellowship and good humor, now, therefore,

BE IT RESOLVED that the Accident Prevention Committee, Edison Electric Institute, at its meeting held in Roanoke, Va., on Feb. 10, 1941, hereby commemorates the contribution made by Charles B. Scott to the cause of accident prevention work in the electric light and power industry, and

The members of the committee extend their sympathy to the members of his family and to his former associates.

By order of the Accident Prevention Committee, copies of the resolution will be sent to members of Mr. Scott's family, and to the Bureau of Safety, Chicago.

RECENT E.E.I. PUBLICATIONS

CABLE OPERATION—1939

EEI. Pub. H-5. A report of the Transmission and Distribution Committee of the Edison Electric Institute, 36 pages. Price 60¢ to members and their employees; $1.50 to non-members in the U.S.A.; $1.60 to foreign countries.

THIS report covers the operation of 16,400 miles of cable, 336,000 joints and 47,900 potheads.

The amounts of 1939 vintage high voltage cable operating at the end of the year, on the systems of the 56 contributing companies, were 292 miles of impregnated paper-insulated cable and 6.0 miles of varnished cambric or rubber insulated cable.

The trouble rate for all high voltage cable was 6.5, a value 3.5 per cent higher than the 1938 rate but 5.8 per cent lower than the average trouble rate for the previous five years.

The failure rate for all cable was 4.6, a value 2.7 per cent lower than the 1938 rate. This rate is the lowest yet noted since 1920 which is the earliest year for which the data is readily available.

The trouble rate for all high voltage joints was 1.8, a value 2.3 per cent higher than was reported last year.

The trouble rate for all potheads of 3.9 is the lowest yet reported since the committee started gathering removal data in 1934. Ninety-one per cent of the potheads included in the tables are on paper-insulated cable. The trouble rate for potheads on paper-insulated cable installed outdoors is more than three times that for potheads installed indoors and is nearly 14 times that of potheads integral with apparatus.

Approximately 70 per cent of the cable and joints covered in this report were subjected to high potential tests. The service failure rate for tested cable for both cable and joints was higher than the corresponding rates for untested cable, the former being 7.3 per cent higher and the latter 17 per cent.

There has been a definite downward trend in the number of high potential tests made during the past five years. Twenty per cent of the 3280 tests made during 1939 were made with a-c potentials and 80 per cent with d-c potentials. Approximately one out of every 14 tests produced a failure. The average ratio of test to operating voltage for a-c test voltages was 1.4, with a maximum ratio of 3.1 and a minimum ratio of 1.0. For d-c test potentials, this ratio was 3.9 with a maximum ratio of 6.3 and a minimum ratio of 1.7.

The joints on 15 per cent of all the solid type, paper-insulated cable covered in this report were connected to oil reservoirs. The trouble rate for this cable was 6.6, the same as for cable whose joints were not connected to oil reservoirs. The average failure rate for cable connected to oil reservoirs during the past six years was 2.8 while for cable not connected to oil reservoirs, the average rate was 5.3.

Data submitted by the Electrical Testing Laboratories covering the assigned causes of 809 cable troubles shows that more than 70 per cent of the troubles were assigned to one of five causes, namely: Cable Movement, Sheath Corrosion, Deterioration in Cable Over 10 Years Old, Initially Defective Sheath, and External Mechanical Damage. These five causes accounted for 27, 20, 8.8, 8.5, and 8.2 per cent respectively of all cable troubles.

DISTRIBUTION TRANSFORMER LOAD SUPERVISION

EEI. Pub. H-6. A report of the Overhead Distribution Group of the Transmission and Distribution Committee, Edison Electric Institute, 33 pages. Price 60¢ to members and their employees; $1.50 to non-members in the U.S.A.; $1.60 to foreign countries.

THIS report is one of a series designed to provide the test and experience data necessary to encourage and enable economical loading of distribution transformers. Practical application of the engineering information that has been made available necessitates a routine schedule for load determination. Many opportunities for investment and operating economies justify this supervision, but, because of the large number of relatively small units involved, it must be done on a mass production basis.

The two previous publications in this series are:

1. Distribution Transformer Load Characteristics, Publication F3, April, 1938.
2. Economical Loading and Thermal Performance of Distribution Transformers, Publication F7, August, 1938.

The first two reports laid the theoretical basis for study of the economical loading of transformers. The present report outlines various methods in use, including both field testing and office record examinations, to determine the actual loads being carried. Methods are given for analyzing local conditions to determine criteria for maximum allowable loading.

INDUCTIVE COORDINATION ASPECTS OF PETERSEN COIL GROUNDING

EEI. Pub. H-3. A report of the Joint Subcommittee of Development and Research of the Edison Electric Institute and the Bell Telephone System, 14 pages. Price 25¢ to members and their employees; 65¢ to non-members in the U.S.A.; 75¢ to foreign countries.

THIS report discusses those features of a Petersen coil-equipped power system which are of importance from the inductive coordination standpoint. As a background for this discussion, a brief description of the theory of operation and extent of use of the Petersen coil is given, following which those features affecting inductive influence, such as residual current distribution, duration of faults and percentage of faults likely to be cleared without breaker operation, are considered in more detail. Consideration is also given to means used for clearing permanent faults and to possible noise induction effects.

BOILERS—COMBUSTION, 1940

EEI. Pub. H-7. A report of the Boiler-Combustion Subcommittee of the Prime Movers Committee, Edison Electric Institute, 103 pages. Price $1.60 to members and their employees; $4.00 to non-members in the U.S.A.; $4.15 to foreign countries.

THIS report contains statements by Operating Companies and Manufacturers on:

Boilers—Pressure Parts
Pulverized Fuel and Furnaces (other than pressure parts of water-cooled furnaces)
Slagging and Furnace Cleaning
Stokers
Oil and Gas Fuel
Combustion Control

Data on Boilers and Combustion heretofore prepared and issued separately have been consolidated in this report. This arrangement by the Prime Movers Committee is designed to provide more direct coordination of related subjects and to avoid previous duplications. Including under one cover these and associated subjects together with a liberal response to subcommittee inquiries for material, the report, comprising in all seven sections, carries an unusual amount of worth-while information from both

manufacturers and operating companies.

From material supplied by boiler manufacturers, definite trends in boiler design and construction are revealed as follows:

Recent high capacity installations for high pressure service indicate the almost complete disappearance of the straight-tube type boiler.

Despite the large variety of designs being offered by manufacturers, individual companies have installed one or not more than two basic arrangements for certain classes of service. Special designs influenced by unusual situations or customer requirements represent only a small part of recent developments. It is of importance to observe, however, that practically all units, regardless of design and furnace arrangement, have the common characteristic of a marked increase in furnace radiant heat absorption surface, with a consequent reduction in convection boiler surface preceding the superheater.

More tube-to-tube surface is being used for furnaces, replacing the block and the fin-tube construction.

Elimination of intermediate headers in furnaces by use of extra long continuous tubes is made possible by field welding. Internal cleaning of these long tubes by turbining or by chemical wash may be somewhat less effective.

Boiler manufacturers have now adopted welded stub-tube type headers for high pressure superheaters and economizers. Rejection of headers with hand holes and rolled tube joints removes one of the most frequent and troublesome causes of boiler outage.

Preference is indicated for water-cooled centralized slag outlets as against drip ledge arrangements.

Steam-temperature control with furnace gas by-pass damper apparatus is less popular. A return to the desuperheater type control is indicated with the installation of equipment on several recent units by two manufacturers, while one other reports satisfactory results with a twin-furnace design in combination with radiant superheater surface. It should be noted, however, that superheat control is dependent to a great extent on the outside control apparatus and there is no certainty, therefore, that the desuperheater system will give any closer regulation. A tendency to increase control damper areas is indicated in recent designs, a change which may effect an increase in the sensitivity of control. Burners and by-pass dampers must be more closely coordinated to achieve the most satisfactory results.

In the matter of steam purification equipment for high pressure installations three boiler companies continue to use steam washers. On the other hand, one company is almost entirely using combination centrifugal separators and scrubbers without feed-water sprays.

To eliminate further the problems of superheater slagging, greater increases in the spacing of superheater tubes are being utilized—particularly in sections of superheaters nearest to the furnace. This trend is emphasized in boilers now under construction which call for convection superheaters in two stages. The superheater tube spacing in the entire high temperature stage is 9⅜ in. corresponding to, and in alignment with, the boiler tube bank preceding the superheater.

Designs of units in the lower capacity range (200,000 lb. per hr. and under) are becoming more or less standardized by each company and consist of compact, complete watercooled furnace and boiler combinations suitable for low head room and minimum floor space. A number of spreader stoker installations are reported under this type of boiler.

The first forced-circulation boiler for central station service in this country was put under construction during the fall of 1940 by one of the leading boiler manufacturers. The unit as ordered by a member company will have a capacity of 650,000 lb. per hr. at 2000 lb. pressure and 960 F. steam temperature with reheating at 400 lb. to 750 F.

During the last few years intensive research has been carried out and great advances have been made in welding and welding processes. These advances have resulted in extended use and wider applications of welding with respect to all parts of the boiler assembly, and have brought about extraordinary economic and technical changes in the design, construction and maintenance of equipment.

From increasingly favorable reports for the year ending mid-summer, 1940, it is evident also that pioneering that had to be done following the inauguration of the high temperature-pressure equipment in 1935-36 has greatly improved the reliability of this type of equipment.

As regards properties of steam for central station designs, steam temperatures at present seem to have reached an upper limit between a normal of 925 F. and a maximum of 950 F. Boilers and turbines for 2000 lb. and for 2500 lb. are under construction but no general adoption of these higher conditions is likely until the reliability of units and the behavior of metals for extended periods at 1250 lb., 950 F., has been definitely established.

STANDARD BASIC IMPULSE INSULATION LEVELS

EEI. Pub. H-8. A report of the Joint Committee on Coordination of Insulation of the American Institute of Electrical Engineers, Edison Electric Institute and the National Electrical Manufacturers Association, 4 pages. Price 5¢ per copy.

THIS report is the culmination of over 10 years' study to arrive at basic Insulation Coordination. It specifies Basic Impulse Insulation Levels, in terms of a withstand voltage for a specified test wave. These values are to be the bases for many other standards.

Manufacturers Catalogue New EEI-NEMA Standard Distribution Transformers

IN late January and February manufacturers issued new transformer catalogues showing revised design features and price levels for distribution transformers manufactured in accordance with the First Report of the EEI-NEMA Joint Committee on Standards for Distribution Transformers. Production of conventional units for stock, in the sizes covered by the First Report, is being discontinued in favor of the new Standard Transformers. Present stocks of conventional units will be depleted as practicable on orders to be filled.

An advanced draft of Second Report of the Joint Committee was discussed at length in the meeting of the EEI Transmission and Distribution Committee in Detroit, Feb. 17-19. A number of constructive suggestions were obtained which have been referred to the Joint Committee for further action. This Second Report will extend the range of standardization to include transformers rated 100 kva and below and also incorporates some detail extensions of the standards for transformers covered by the First Report. These extension items, presented to the T&D Committee by a descriptive abstract, were voted approval. When similarly approved on the part of NEMA, it is intended that the items be made generally available and effective through a printed supplement to the first report. Thereafter, these features will be incorporated in the Standard Transformers as rapidly as manufacturing conditions will permit.

PERSONALS

E. A. LEWIS, vice-president and general manager of Atlantic City (N. J.) Electric Company since 1931, has been appointed vice-president and general manager of Indiana and Michigan Electric Company, South Bend, Ind. He succeeds the late T. F. English. Mr. Lewis began his utility career with the Public Service Company of Northern Illinois in 1903. In 1908 he joined the electrical department of the Lincoln Park Commission of Chicago. He first went to Atlantic City in 1911 and served there as general superintendent until 1919, when he went to Scranton Electric Company in the same capacity. Returning to Atlantic City as assistant general manager, he was made vice-president and general manager in 1931.

RALPH E. MOODY, formerly an officer of the Wisconsin-Michigan group of companies in the North American system and more recently an assistant to the president of North American Company, has been elected a vice-president and a director of the company.

Three more new directors, named to fill vacancies on the North American board, are:

E. G. CRAWFORD, president, Cleveland Electric Illuminating Company;

WILLIAM MCCLELLAN, president, Union Electric Company of Missouri;

A. G. NEAL, president, Washington Railway and Electric Company and Potomac Electric Power Company.

W. H. DORAN, formerly a vice-president of New York State Electric and Gas Corporation and manager of its central division, has been elected a vice-president of Metropolitan Edison Company, with headquarters at Reading, Pa. Beginning 20 years ago as a meter reader for Depew and Lancaster (N. Y.) Light and Power Company, Mr. Doran became new business manager of the western New York group for New York State Electric and Gas in 1934. Two years later he was made division manager and in 1937 he was transferred to the central division as vice-president and division manager.

JACK G. HOLTZCLAW, president, Virginia Electric and Power Company, has been appointed a district coordinator of the defense contract service, under the Office of Production Management.

Philadelphia Electric Company recently announced organization changes involving personnel re-assignments.

R. G. RINCLIFFE was appointed manager of the station operating department, of which C. C. Baltzly continues as general superintendent.

ALEX WILSON, 3d, was named manager of the transmission and distribution department.

G. S. VAN ANTWERP was appointed general superintendent of transmission and distribution.

C. D. BUCHHOLZ was made general superintendent of the service operations department under R. Z. Zimmermann, manager.

W. C. PIERSON was appointed superintendent of the appliance service division.

ARTHUR L. CARVILL, formerly with Public Service Electric and Gas Company, Newark, N. J., in the meter department, has joined the electrical engineering staff of Ebasco Services, Inc., New York.

CHARLES H. SILVESTER, division manager for The Detroit Edison Company at Lapeer, Mich., has been transferred to Port Huron as manager of the combined Lapeer and Port Huron divisions.

L. G. SMITH, assistant to the general superintendent, Consolidated Gas Electric Light and Power Company of Baltimore, has been called into army service as a lieutenant-colonel assigned to the School of Command at Fort Leavenworth, Kan.

A resignation and four promotions have been announced by Arkansas Power and Light Company.

FRANK M. WILKES resigned as operating vice-president to join Southwestern Gas and Electric Company, Shreveport, La., as assistant to the president and general manager.

H. FLETCHER MINNIS has been promoted from manager of the northeast division to operations manager of the company, with headquarters at Pine Bluff. Mr. Minnis came to Arkansas Power and Light in 1924 as a commercial salesman and was appointed northeast division manager later in the same year.

RALPH D. CALDWELL, formerly local manager at Camden, will succeed Mr. Minnis as manager of the northeast division with headquarters at Searcy.

JOHN FITZGERALD has been promoted from local manager at Newport to local manager at Camden, succeeding Mr. Caldwell.

E. W. LAWRENCE, formerly manager at Brinkley, has been made manager at Newport.

MAJOR-GENERAL HARRISON G. WINSOR, personnel officer of Puget Sound Power and Light Company, has been appointed as a district representative to assist in the formation of a program under which industry will train its defense workers.

J. ERNEST STOTT, safety director for Georgia Power Company, has been appointed by the National Committee for Conservation of Man-Power in Defense Industries as a special agent to advise industries how to prevent loss of manpower through illness and accidents. He will continue his regular work with Georgia Power.

Deep Underground Conduit Installation

(*Continued from page* 87)

vantages in using this method which are summarized as follows:

1. The principle of employing a casing to precede the duct installation and of removing the soil during the pushing process makes it possible to push into the ground precast duct lines having relatively large cross sectional areas. Any attempt to push a pipe as large as the casing described for any considerable distance without removing the soil would require excessive pushing pressure and might cause the street surface to buckle, particularly if the installation was being made reasonably close to the surface. Furthermore, any means of soil removal which reduces the resistance encountered by the casing at its forward end will tend to insure good directional control. The casing principle may also be used successfully by substituting some suitable mechanical means for the sluicing devices to break down and remove the soil.

2. The manner in which the standard "caisson" method of installing precast manhole walls was adapted to shaft building indicates the possibility of like use in the future.

3. The circular arrangement of the outer ducts is ideal for maintaining low ambient temperatures at the cables.

(*Cont'd next page*)

4. Trenching and shoring were eliminated with the resultant saving of pavement.

5. Traffic congestion and delays were avoided.

6. Greater safety was afforded to pedestrians and utility company forces.

7. The temporary supporting of cables and duct structures in the excavation during the construction project was not required.

8. A saving of approximately 56 per cent was realized on the installation described compared to the estimated cost of doing the work by usual methods. Appreciable savings should also be realized with this method on other installations depending upon depth, surface and subsurface conditions.

Adequate Street Lighting

(*Continued from page* 92)

greater share of the night accident reduction.

Data such as these, properly publicized, cannot fail to impress local authorities and help them justify increased expenditures for street lighting.

Another fact worthy of mention is that automobile insurance rates are generally based to a considerable degree on long-term accident experience of established districts. Thus resident automobile owners have a financial interest in accident reduction. And it is a fact that the automobile insurance rates for the Hartford territory have been substantially reduced since the inauguration of this street lighting improvement program.

It will be noticed that no attempt has been made to evaluate the lives saved in the reduction of fatal night accidents on the relighted streets. It is difficult to place a true value on a human life, so let us be content to examine merely the records of day and night deaths for comparable periods before and after modernization on the 10 miles of Hartford streets. They are shown in the following table. Here again we have strong and convincing proof that adequate lighting is a valuable community asset.

	Day Deaths	*Night Deaths*
3 Years Prior to New Lighting	3	27
3 Years After New Lighting	5	1
Per Cent Increase	+66	....
Per Cent Decrease	....	—96

It seems to me that aside from the purely commercial aspect of added revenue from street lighting, it should be recognized that with this product of electricity our utilities are in a truly fortunate position to improve and strengthen their public relations. Remember, we are dealing with lives and limbs, and something definitely tied up with the public welfare. So why not take advantage of our position before our critics start out on another crusade which we should have led—this time night safety?

CONVENTIONS AND MEETINGS

MARCH

13-14 Southeastern Electric Exchange, Engineering and Operation Section, DeSoto Hotel, Savannah, Ga.
17-18 Oklahoma Utilities Association, Tulsa, Okla.
27-28 Missouri Valley Electric Association, Continental Hotel, Kansas City, Mo.
27-29 Northwest Electric Light and Power Association, Business Development Section, Davenport Hotel, Spokane, Wash.
31-Apr. 1 Power Sales Conference, Edgewater Beach Hotel, Chicago, Ill.
31-Apr. 3 Annual Sales Conference, EEI, Edgewater Beach Hotel, Chicago, Ill.

APRIL

7-8 5th National Accounting Conference, AGA-EEI, Netherland Plaza Hotel, Cincinnati, Ohio.
14-15 Missouri Valley Electric Association, Rural and Sales Conference, Continental Hotel, Kansas City, Mo.
18 Maryland Utilities Association, Lord Baltimore Hotel, Baltimore, Md.
23-25 Missouri Association of Public Utilities, The Elms, Excelsior Springs, Mo.
28-29 Arkansas Utilities Association, Arlington Hotel, Hot Springs, Ark.
29-30 Chamber of Commerce of the U. S. A., Washington, D. C.

MAY

1-3 Southeastern Electric Exchange, Annual Convention, Bon Air Hotel, Augusta, Ga.
5-8 Engineering Committees, E.E.I., Edgewater Beach Hotel, Chicago, Ill.
11-15 National Electrical Manufacturers Association, The Homestead, Hot Springs, Va.
12-17 National Fire Protection Association, Royal York Hotel, Toronto Can.
18-23 National Electrical Wholesalers Association, The Homestead, Hot Springs, Va.
21-24 Pacific Coast Electrical Association, Annual Convention, Hotel del Coronado, Coronado, Calif.
22-23 Missouri Valley Electric Association, Accounting Conference, Continental Hotel, Kansas City, Mo.
23-27 Westinghouse Agent-Jobbers Association, The Homestead, Hot Springs, Va.
26-29 National Association of Purchasing Agents, Chicago, Ill.

JUNE

2-5 EDISON ELECTRIC INSTITUTE, Buffalo, N. Y.
10-13 National District Heating Association, William Penn Hotel, Pittsburgh, Pa.
16-20 American Institute of Electrical Engineers, Summer convention, Toronto, Can.

Flow Phenomena in Wake of Smokestacks

A Study of Flow Phenomena in the Wake of Smokestacks, Bulletin No. 29, Department of Engineering Research, University of Michigan, Ann Arbor, Mich. 52 pp., 34 Fig. ($1.00). By R. H. Sherlock and E. A. Stalker.

THIS bulletin describes in detail the test methods and results of an investigation to determine whether or not an addition to the height of the existing stacks would prevent the down-flow of stack gases which was occasionally observed in the area surrounding the Crawford Station of the Commonwealth Edison Company in Chicago.

Theoretical and experimental studies were made to determine the cause of downwash of stack-gases and to discover any possible methods of preventing it. Models of the complete station and of isolated stacks were made and tested in the wind tunnel at the University of Michigan.

It was found that wind velocity is the only weather condition influencing the downwash of the stack gases, and that downwash is accomplished in two steps. The first step is induced by the eddies in the wake of the stack, and the second is the dispersion of the gas within the turbulent mass of air above and behind the station buildings.

The first step follows fairly definite laws involving wind velocity, stack-gas velocity and stack-gas temperature.

The critical height to which the influence of the buildings extends in producing the second step of downwash depends upon the shape and proportions of the buildings, and the direction of the wind. At the Crawford station, the critical height is greatest with the wind blowing from a South-Westerly direction. The addition of 50 ft. to the height of the stacks raises them above this most critical height. This prevents downwash from any direction, provided that the stack-gas velocity is high enough to prevent the first step of downwash.

It was recommended that 50 ft. be added to the height of the stacks, using nozzles so as to increase the velocity of the stack gases. This was done and no further downwash was observed at the station.

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1940-1941

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Depreciation, H. L. GRUEHN, Consolidated Gas Electric Light & Power Co., Baltimore, Md.

Plant Accounting and Records, H. B. HARDWICK, The Commonwealth & Southern Corp., New York, N. Y.

Purchasing Stores and Transportation (To be announced)

Electric Equipment, R. W. WILBRAHAM, United Engineers & Constructors, Inc., Philadelphia, Pa.

Hydraulic Power, E. B. STROWGER, Buffalo, Niagara & Eastern Power Corp., Buffalo, N. Y.

Insurance, J. H. NICKELL, Philadelphia Electric Co., Philadelphia, Pa.

Membership, EDWARD REYNOLDS, Columbia Gas & Electric Corp., New York, N. Y.

Prime Movers, E. L. HOPPING, Philadelphia Electric Co., Philadelphia, Pa.

Prize Awards, H. P. LIVERSIDGE, Philadelphia Electric Co., Philadelphia, Pa.

Rate Research, F. A. NEWTON, The Commonwealth & Southern Corp., New York, N. Y.

General Sales, R. E. FISHER, Pacific Gas & Electric Co., San Francisco, Cal.

Statistical, W. T. NEEL, Philadelphia Electric Co., Philadelphia, Pa.

Transmission and Distribution, W. F. NIMMO, Virginia Electric & Power Co., Richmond, Va.

Codes and Standards (a Subcommittee of the Operating Committee)
(To be announced)

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JUSTIN R. WHITING.....The Commonwealth & Southern Corporation, New York, N. Y.

(*Terms expiring* 1943)

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GEORGE N. TIDD.....American Gas & Electric Company, New York, N. Y.
JOHN E. ZIMMERMANN.....The United Gas Improvement Company, Philadelphia, Pa.